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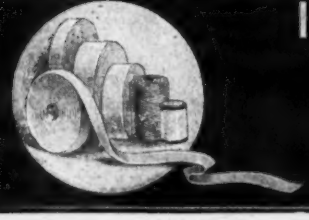

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THE

ELECTRICAL REVIEW.

VOL. XC. FEBRUARY 17, 1922. No. 2,308.

ELECTRICAL REVIEW.

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THE INSTITUTION OF ELECTRICAL ENGINEERS.

HALF a century ago, the Society of Telegraph Engineers held its first meeting; on Tuesday next the Institution of Electrical Engineers, the same body with a more comprehensive title, will commence a series of meetings in commemoration of that notable event. The celebration will be observed with keen interest by electrical engineers in all countries, above all by those of British nationality, for it is something more than the rejoicings of a technical association—it is a function of national importance. What a vast gulf separates us of to-day from those pioneering times, when even amperes and volts were unnamed! We, with our 100,000-kilowatt power stations, our 10,000-h.p. motors, our 12,000-mile range wireless plant, our electric furnaces, our electrons, our X-rays—we move in a different atmosphere, electrically speaking, to that which bathed the telegraph engineers who then constituted the mainstay of electrical engineering.

But they, too, had their triumphs; they had but lately linked-up this country with India and the East and flung a line of instantaneous communication across the Atlantic, and thus commenced the development of that wonderful network of submarine cables with which British engineers encompassed the world and annihilated distance. As early as 1818 Sir Francis Ronalds had proposed to transmit intelligence electrically, and had even erected some miles of wire in his garden at Hammersmith to put his theories to the test; he was years before his time, but at the age of 84 years he had the satisfaction of witnessing the formation of the Society of Telegraph Engineers, which now, under another name, is the custodian of his splendid library.

In those days there was no electrical newspaper in being; there had been one, for a few years, but it was defunct, and the TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW, the oldest electrical periodical in existence to-day, was not born until November, 1872. Hence the only contemporaneous record of the first meeting of the Society, apart from the lay Press, is to be found in the *Journal* of the Society itself. How many of our readers or of the members of the I.E.E. have opened that first volume? It is of absorbing interest. In its pages will be found the wonderful forecast of Cromwell Varley, which we quote elsewhere in this issue; with prophetic insight he predicted the development of the Society out of its narrow groove into the broader field of all electrical science, which he claimed would be found "to embrace every operation in nature." It may yet prove that all nature—or at least all matter—is electricity.

Many other items of fascinating interest are printed in those pages. In the very first volume is reported a speech by W. H. Preece, and a note by H. R. Kempe—both of whom in their time were editors of this journal (the latter is still connected with it).

In those early days the progress of electrical engineering was not yet swathed in the bonds of oppressive legislation; electricity was free to develop, British electricians were far in advance of their foreign *confrères* in ingenuity and enterprise, they had the world at their feet! To what heights might they not have advanced

had they been left free to follow their bent! But alas—Parliament intervened, and in 1882 it let fall the portcullis which deprived them of their liberty, and condemned them wistfully to watch the untrammelled advance of their foreign rivals, themselves in bondage. Nevertheless, the country that had given birth to Gilbert and Faraday, Newton and Thomson, was not to be wholly defeated. The fertility of its genius could not be sterilised by Act of Parliament, and its contributions to electrical science and engineering are unexcelled by those of any other nation. The records of them all are to be found in that magnificent series of 60 volumes which contains the proceedings of the Institution of Electrical Engineers, founded 1871, incorporated by Royal Charter 1921, the oldest electrical society in the world, the biggest engineering body in this country.

Its members are proud of it—and well they may be.

The E.P.E.A.

Those who were fortunate enough to be present at the Informal Meeting of the Institution of Electrical Engineers on Monday last were presented with an oration by Mr. J. H. Parker which was a delight to hear and which held the audience for an hour and a quarter. We use the word "oration" advisedly, and in no depreciatory sense; it is not the first time that we have recognised the gifts of Mr. Parker as an orator, and the chairman, Mr. Pooley, justly styled the address "entrancing." Yet the subject with which the speaker dealt was not one which would appear well adapted to the exercise of rhetorical talent; nominally he was to open a discussion on "The Evolution of a Staff Trade Union," and in the earlier part of his speech he certainly referred at some length to the process of evolution of the E.P.E.A., but in the main he gave a vivid, sometimes perhaps lurid, account of the acts of the Association, the vicissitudes through which it had passed, the problems with which it had been perplexed, its triumphs and—its failures. He made it clear that during his tenure of the office of president the life of the executive council and officials had been strenuous in the extreme, and that they had had to deal with questions of the gravest import not only to their Association, but also to the realm.

A point on which he laid particular emphasis was that the E.P.E.A. was not out to fight any other trade union; its members were determined to control their own destinies, but not at the expense of others. He paid a glowing tribute to the sterling merits of the central-station members of the E.T.U., who more than once had successfully thrown their weight into the scale in opposition to strikes with which the electricity supply industry had no concern. The policy of the E.P.E.A. was to avoid resort to strikes until every other means of securing justice had been exhausted, and by its public-spirited action on one occasion it had earned the gibe of a Government official that its members "had acted as good citizens but bad trade-unionists"—a remark as tactless as unworthy of a representative of orderly government. The Association's experiences of the benefits derived from Government intervention in industrial affairs appear to have been as disappointing as those of other parties, and its regard for the integrity and good faith of certain Town Councils has been hopelessly destroyed. However, exceptions do not make rules, and on the whole the situation at present appears to be fairly satisfactory.

Mr. Parker undoubtedly spoke the mind of the Association when he demonstrated its intense desire to maintain the continuity of electricity supply, and faithfully to discharge its acknowledged duties to the public; he pointed out that the lay Press eagerly seized upon and distorted rumours regarding the acts and intentions of the Association, and declined to rectify its aspersions when made acquainted with the facts, and he claimed that the members should be regarded as sensible and moderate men, who would do nothing rashly. In the light of recent history we believe his claim to be entirely justified, and we have no hesitation in expressing our confidence in the Association as an organisation whose activities are directed to the best interests of the electricity supply industry and of the nation.

Sale of Fixed Machinery.

Those who are concerned with the sale of machinery should note the decision of Mr. Justice Rowlatt in the case of Underwood, Ltd., *v.* Burgh Castle Brick and Cement Syndicate, which is reported in the February number of the *Law Reports*. Although primarily of interest to lawyers, the finding of the learned judge draws attention to a very real distinction between the sale of chattels and the sale of articles attached (as machinery often is) to the freehold. The facts were these: The plaintiffs agreed to sell to the defendants a condensing engine "to be delivered free on rail." At that time the engine was affixed to the soil, and was a trade fixture on the plaintiffs' leasehold premises. The plaintiffs detached the engine, but in loading it up for delivery it was so badly injured by an accident that the defendants refused to accept it. It was held that as the defendants intended to buy a chattel, and as, in order to make it a chattel, it had first to be severed from the soil, the property did not pass until it had been severed and delivered under the contract, and, accordingly, that the property therein had not passed to the defendants at the time of the accident. Had the property so passed, of course, the defendants would have been bound to take it in the damaged condition, although they might have had a claim against the plaintiffs for breach of contract or negligence. The interesting point which was clearly brought out is that if the vendor of an engine or any other piece of machinery which is affixed to the freehold desires to transfer all the risks attendant upon removal to the purchaser, he must be careful to use express words. It is made plain by Section 18 of the Sale of Goods Act that in the case of an unconditional sale of specific goods in a deliverable state, the property passes when the contract is made. So if, in the case above noticed, the engine had not been fixed to the freehold, the loss occasioned by the accident would have fallen on the buyer.

Electric Heating.

An inquiry for an electrically-heated oil filter which appears in our "Correspondence" columns to-day reminds us of an opinion which we had recently formed—that there are many cases in works and factories in which electrical heating could be advantageously substituted for the methods at present in vogue. No doubt there is a general impression, sedulously fostered by rival agencies, that heating by electricity is a costly proceeding; but in this connection, as in many others, much depends upon the circumstances. Where, as in the case of oil filters, practically the whole of the heat can be usefully applied, and can be efficiently conserved by the use of suitable lagging, and where a very small wattage continuously applied will serve the purpose, it may easily prove that electricity not only possesses the obvious advantages of extreme convenience and simplicity, but is also the cheapest means of effecting the heating.

The heating element can often be entirely enclosed or immersed in the substance to be heated, and the total absence of flame, combined with freedom from the need of a supply of air for combustion, greatly facilitates the lagging with heat-insulating material. Hot-water pipes are equally free from flame and air supply, but suffer from the drawback that with them the heat is transported, instead of being generated at the spot where it is used, and the heating fluid necessarily carries away a large proportion of the heat in the return pipe, whilst the system is liable to large losses by radiation and convection. In cases where electricity is available or can be purchased at a low price when taken at a low wattage and a high load factor, its merits as an industrial heating agent are incontestable.

THE WITTON ENGINEERING WORKS OF THE GENERAL ELECTRIC CO., LTD.

The electrical industry is unique in the extraordinary development which it has undergone in a comparatively very short period, comprised wholly within the lifetime of many persons who are still hale and hearty, and indeed, so far as concerns the "heavy engineering" branches, almost within the current century. The General Electric Co., Ltd., was founded practically at its very genesis—over five and thirty years ago—and we remember when there was no "G.E.C., Ltd."!

But though the company thus started from "scratch," its efforts in those days were directed mainly towards the lighter side of the industry, and it was not until February 7th, 1901, that a commencement was made with the huge group of factories on the outskirts of Birmingham which now constitute the well-known "Witton Engineering Works" of the G.E.C. On the 21st anniversary of that event, last week, we had the pleasure of taking part in a visit to the works and of comparing their present development with that which we had seen on various occasions during the years before the war, and we tender our congratulations to the company not only on the celebration of the "birthday," but also on the great extensions which have been carried out and on the improved methods of manufacture which have been introduced.

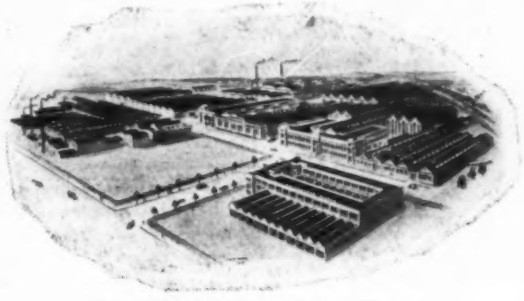

Fig. 1.—The G.E.C. Witton Works.

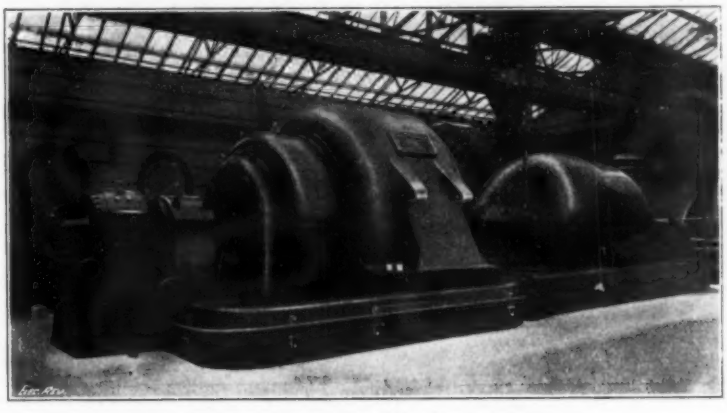

Fig. 2.—A G.E.C. 4,500-kVA Turbo-Alternator.

At the annual general meeting of the company in July, 1918, Mr. Hugo Hirst, chairman of directors, declared that the G.E.C. intended to take a place in the front rank of great electrical concerns in this country; since then a large scheme of extensions has been carried out, more than doubling the size of the works at Witton, in which the company is now able to manufacture the heaviest machines commercially practicable, and to design and construct electrical plant and control gear for the complete equipment of power stations, railways, ships, mines, steel works, &c., whilst with the aid of the associated firms (Pirelli-General Cable Works, Fraser and Chalmers, Osram Lamp Works, &c.) it can supply practically everything required for a comprehensive lighting, power, or other electrical engineering scheme from start to finish. Together with the Witton Works there has grown up a township populated by the company's employés and the tradesmen and others who minister to their physical, social, and moral requirements.

There are now about 2,500 employés engaged in the works, but when trade revives another thousand can be employed.

The extensions comprise in all seven new buildings:—switchgear works, standard motor works, administrative offices, development department, moulded-insulation works, enamelling and plating works, and a large club house, whilst new bays have been added to the foundry, main engineering works, and small motor works. A large number of special machine tools have been installed; up-to-date methods of transportation have been adopted, with liberal provision of gangways in the shops and roadways between them; and the organisation of the work has been remodelled. In addition to the factories named above, there are on this site the "Freezor" fan works, carbon works, and conduit works.

The main engineering works are now set apart for all classes of electrical machinery of 100 h.p. and upwards, including turbo-generators, low-speed generators, rotary converters, and motors, and a full equipment of machine tools is provided capable of dealing with the largest machines required in modern practice. Numerous turbo-alternators were being built at the time of our visit, and it may here be noted that the G.E.C. has always employed the solid rotor for these machines, with successful results. All G.E.C. turbo-alternators of 6,000 kVA and upwards are provided with embedded temperature detectors. The machines in hand ranged from 3,000 to 22,500 kVA, and were destined for the Borough of Marylebone, Bury Corporation, Guest, Keen & Nettlefolds, Bolckow Vaughan & Co., Darlington, Newport, Pretoria, Auckland, and various other British towns and works; most of them were designed to run at 3,000 r.p.m. A recent order is a 25-cycle, 22,500 kVA set to run at 1,500 r.p.m., for Birmingham.

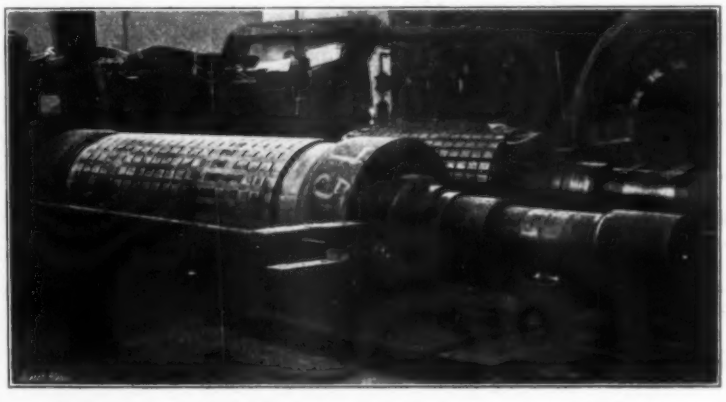

Fig. 3.—An 8,000-kVA Rotor (Solid Type), to run at 3,000 r.p.m.

Nearly all these alternators are to be driven by G.E.C. turbines made by Fraser & Chalmers. Several large

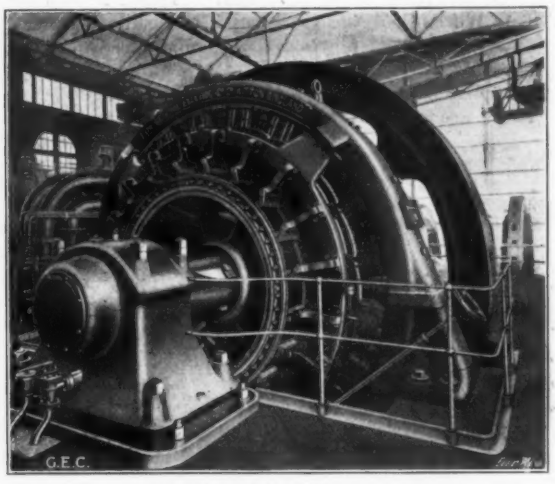

Fig. 4.—A G.E.C. 1,150-kW d.c. Generator.

rotary converters were also in course of construction, from 1,000 to 2,000 kW, for London supply companies and other purchasers. With these machines a self-synchronising panel is supplied, embodying many G.E.C. patents, for which important advantages are claimed. On this system the windings of the starting motor are not used as reactances for the main current. A converter built for the British Mannesman Tube Co. had a double commutator to deal with a current of 5,000 amperes, and two similar machines for a British paper mill were passing through the shop. Rolling-mill d.c. motors of 500 to 4,000 h.p. were being built, the last-named being provided with an Ilgner motor-generator set, for driving a 26-in. reversing mill. An a.c. motor of 900 h.p. to drive a mill in Scotland at 75 r.p.m. was also under construction. A "Witton" motor of 10,000 h.p. has been built to drive one of the largest three-high non-reversing mills in existence.

A special type of three-phase totally enclosed motor for steelworks has been designed to be capable of quick dismantling; over 100 machines of this type have been supplied to Messrs. Dorman, Long & Co.'s Redcar steelworks, and several were being built. Kapp phase-advancers and the induction-type synchronous motor were also seen in the shop.

The foundry is believed to be the largest of its kind in the Midlands, and is capable of dealing with castings up to 30 tons in weight. It is well equipped with cranes, lifts, moulding machines, and other mechanical aids, including jar ramming machines, the largest of which can ram a box of sand weighing 10 tons. The compressed air for the foundry machinery is supplied by a large plant in a separate building.

Special interest attaches to the switchgear works, which covers an area of 100,000 sq. ft., and is laid out on most carefully planned lines to facilitate quick production. The switchgear ranges from starters and controllers to the heaviest types of oil circuit-breakers for 33,000 volts, capable of breaking 800,000 kVA.

A large amount of work was in progress at the time of our visit, including the equipment of a new three-storey switch house for the Metropolitan Railway, London, to control the output of six turbo-alternators at 11,000 volts, a total of 37,000 kVA, all electrically remote-controlled; the main oil switches have a breaking capacity of 350,000 kVA each. Some 33,000-volt switches were being built for a South Wales company, and others have been supplied to a South American mining company. Truck-type cubicles were being erected, and over a hundred of this type have been dispatched recently to Bagdad, Calcutta, Bloemfontein, &c.; this type is built for 11,000 volts. Various types of oil-immersed starters and controllers, in flame-proof cases, were being made for collieries, and draw-out oil switches with safety features, pedestal switches with bus-bars to form "unit-type" switches, &c., were seen. On the test bed was a panel equipped for testing the G.E.C. biased differential system of cable protection, made under McColl's patents. In addition to the foregoing there were many lines of ironclad switchgear, lightning arresters, switch and fuseboards, &c., of more modest dimensions.

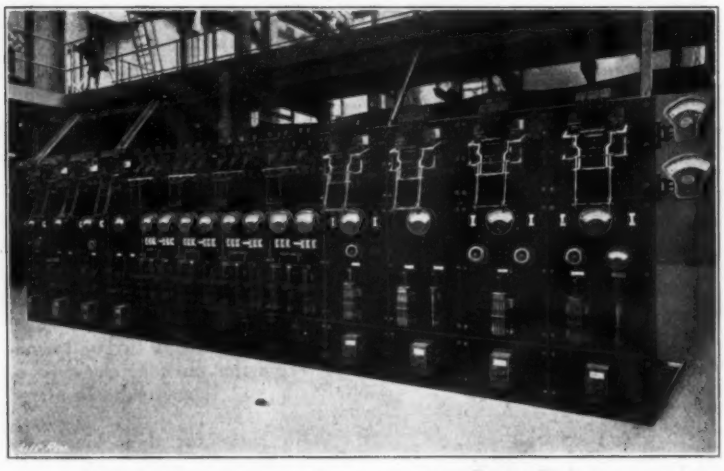

Fig. 5.—Switchboard Controlling Four 2,000-kW G.E.C. Rotary Converters at Bankside Station.
In the centre are four G.E.C. Self-synchronising Panels.

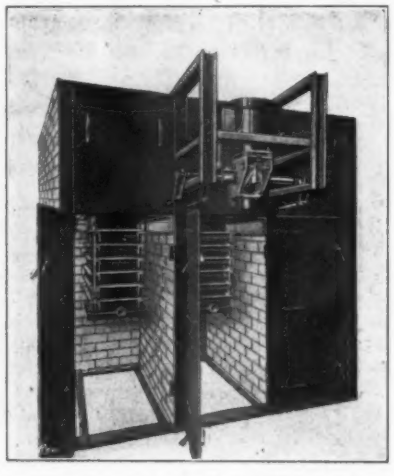

Fig. 6.—A 400-A, 45,000-V, Oil Switch (Type VII.).

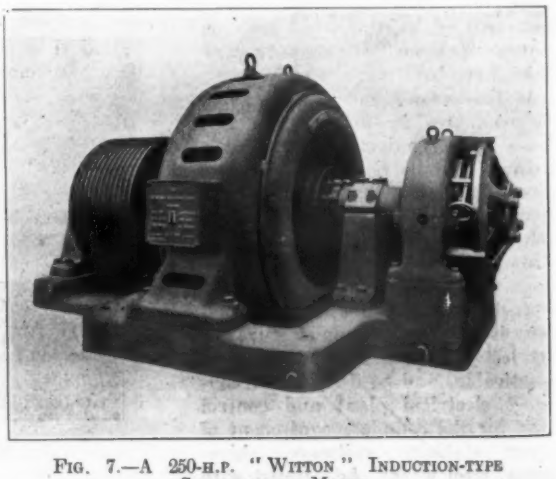

Fig. 7.—A 250-h.p. "Witton" Induction-type Synchronous Motor.

The "standard motor works" has been specially equipped for the rapid production of standard a.c. and d.c. machines from 10 to 500 h.p., and the "small motor works" deals with motors and generators from the smallest sizes up to 10 h.p. Buffing, plating, enamelling, dipping and other subsidiary processes are carried on in separate shops, in which care has been taken to carry off all fumes and vapours. Enamel and lacquer are applied solely by compressed air. These shops are additional to those connected with the switchgear works, which is entirely self-contained.

Recognising the necessity of carrying on research work, the G.E.C. some years ago commenced the organisation of a central research laboratory at Wembley, near London, and development departments at its various works which link up the central laboratory with the production departments. The development department at Witton has been lavishly equipped with apparatus for effecting all kinds of electrical, magnetic, mechanical, and chemical tests, workshops for constructing the models on which new lines of manufacture are based, and photomicrographic apparatus. Pressures up to 50,000 volts are here available, but at the switchgear works test pressures up to 100,000 volts are employed.

One of the most notable additions to the works is the "Magnet" club house built by the company in memory of the many employés who gave their lives in their country's service; close by are playing fields, tennis courts, &c., and these are fully utilised by the workpeople in their leisure hours. The G.E.C. has always made a special feature of its social work, and its efforts have been thoroughly appreciated by the thousands to whom its factories afford a means of livelihood.

Dr. A. H. Railing, managing director of the Witton Works, presiding (in the unavoidable absence of Mr. Hugo Hirst) at a luncheon given to the visitors, laid stress on the fact that the G.E.C. was now in a position to carry out contracts for every kind of heavy electrical engineering plant, and remarked that 40 per cent. of the output of the works was destined to meet orders from abroad. The directors held that in order that this country should secure its full share of the world's engineering orders, it was essential that our manufacturers should be able to deal with all the technical, scientific, and financial problems that arose, and the G.E.C. had therefore aimed at placing itself in a position to do everything electrical whilst relying entirely on its own resources.

The general impression resulting from our visit is that the Witton works, with the associated turbine and cable factories, are capable of tackling any power-station contract that comes their way, and of executing the work in first-class style; that the G.E.C. is equipped with plant and staff for "heavy electrical engineering" has been convincingly demonstrated, though the long list of important orders executed during recent years renders proof superfluous. The latest contract placed with the company, as mentioned in our last issue, is one of exceptional importance, not so much on account of its value as of its significance. It is an order for the provision of the whole of the electrical equipment for 12 additional motor coaches of 1,000 h.p. each, to enable the London, Brighton & South Coast Railway to operate its line from Balham to Croydon electrically. The motors will be of the single-phase type, formerly obtained from Germany, but now to be manufactured at the Witton works, and the contract, which is valued at about £180,000, is the first of several which will probably be settled in the near future. The work will be put in hand within the next two months, and is to be completed within 12 months. Thus the G.E.C. on its 21st birthday made its *début* in railway electrification with alternating current, a circumstance which on every count is a matter for hearty congratulation, and of happy augury for the future.

Unemployment.—The number of unemployed on January 31st was 10,882 less than a week earlier, being 1,904,300.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Hand-drying Machine.

A machine for drying, by means of heated air, the hands and face after washing, was recently described by the *Electrical News* (Toronto). The apparatus is made by the Airdry Corporation, of Groton, New York; it consists of a combined motor-driven fan and a heating element mounted on a white enamelled standard. The apparatus is plugged into a lighting circuit and the fan and heating element are put into operation by means of a pedal switch in the base of the standard. It is considered an extremely sanitary substitute for towels, being particularly adapted for use in public lavatories, factories, &c.

The "Lomax" Lampholder.

One of the most annoying of the tasks which fall to the electrical wireman is the wiring of lampholders. In a small space he has to insert leads and persuade them to enter tiny terminal holes, often at an awkward angle; and then after tightening up the clamping screws, which the average screwdriver is not small enough or sharp enough to deal with, he has to screw down a ring over the porcelain; finally he has to force the little split wood cones which clamp the leads into the top of the holder and tighten them up by means of a

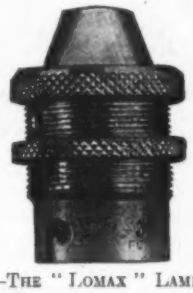

Fig. 1.—The "Lomax" Lampholder.

screw cap. Some designs of lampholder lend themselves to the easy execution of one or two of these operations, but few, if any, are made with a view to ease of wiring throughout. It was, therefore, with no little satisfaction that we recently examined a lampholder which breaks away from convention, and which is claimed (a claim which we believe to be true) to eliminate half the time usually spent on wiring a lampholder.

This, the "Lomax" holder, produced by the Compression Starter & Switchgear Co., Ltd., Penny Lane, Lancashire Hill, Stockport, comprises five parts: (1) A porcelain insulator

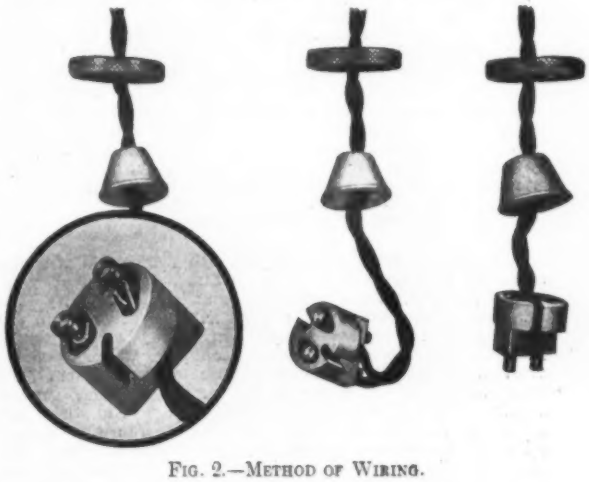

Fig. 2.—Method of Wiring.

with diametrically-opposite axial slots in a circular top; passing through this are two hollow spring plungers, in the top of which are cheese-head terminals sliding in the bore of the plungers; the pressing of the plungers raises these, but their movement is also independent of the upward movement of the plungers when their heads are held in position. (2) A porcelain cap fitting on the top of the interior, keeping the terminal heads pressed down. (3) A screwed brass cylinder fitting over the interior and having slots for the lamp pins. (4) A brass ring screwing over (3) and pressing down the porcelain cap (2). (5) A shade ring.

The holder is wired as follows: The cap and top ring are passed up the flex and the bared ends of this are threaded upwards through two small holes in the porcelain interior. The terminal heads are raised by pressure upon the plungers and the bared wires are coiled under them. When the terminal heads are released they fall back and grip the wires. The leads are then passed upwards through the slots in the porcelain, the cap is brought down upon the terminal heads, and fixed by means of the brass ring. The advantage of the device will be apparent to our readers.

The "Boreas" Portable Air-Blast Set.

Fig. 3 illustrates the latest type of "Boreas" air-blast machine made by Messrs. Lacy-Hulbert & Co. (1921), Ltd., 91, Victoria Street, S.W.1. The set consists of a high-speed positive rotary compressor, driven by a light and efficient 1-h.p. motor. The whole is mounted on a substantial base,

Fig. 3.—The "Boreas" Portable Air-Blast Machine.

to which are fitted small wheels or castors. The compressor is totally enclosed, and runs on ball bearings; the motor has oil-ring bearings and ventilated covers. The equipment is supplied with 6 ft. of flexible hose with an insulated nozzle. The standard sizes are built for operation on 110 or 220-V d.c. circuits, but other voltages can be arranged for.

Artistic Light Shields.

The incandescence without combustion, which is the peculiar feature of electric light, permits of the use of devices which it would be impossible to employ with other forms of illumination. A form of light shield is being produced by Messrs. Spicer & Co., Ltd., 41, Red Lion Street, Clerkenwell, E.C.1, which is a departure from the usual lines. These "Osiris" shields are made in a variety of shapes, the most effective of which is probably the bird form. These models of birds and bats are taken from Nature, the bodies being made of cork and the wings of beautifully-coloured Shantung silk, hand-painted under the supervision of an exhibitor at the Royal Academy and the Paris Salon. The shields are attached by means of a counter-balanced wire fitting to the lampholder, being held in position by the shade ring. Other models produced take the form of masks, which can be attached to the "pips" of inverted lamps fitted in table standards. The light shields are stocked in a number of colours, but special tints can be reproduced to customers' requirements.

Alternative Passenger Transport.—In the course of a discussion at an Institute of Transport meeting held at Warrington recently, it was suggested that the availability of a cheap and abundant supply of electricity might result in the development of railless systems in those places where it was not possible, owing to the expenditure which would be involved, to run the ordinary electric tramway track. The point was raised in a lecture by Mr. E. H. Edwardes, general manager of the Lancashire United Tramways, Ltd., who discussed the relative merits of the electric tramway, railless trolley traction, motor omnibuses, and motor coaches. Mr. Edwardes said that in his opinion all these systems had come to stay, would be further developed, and become more efficient. From estimates, after taking into account capital expenditure, the most economical form of road transport for heavy traffic, with regular services of not less than ten minutes' frequency, was the electric tramcar; for services of ten to twenty minutes' frequency, railless trolley traction; and for anything less frequent, the motor omnibus. A form of traction had yet to be invented which could move large numbers of people reliably and quickly more cheaply than the electric tramway. The railless trolley system would be extensively used in such cases where tramway tracks required reconstructing, but where, owing to the sparseness of traffic, such reconstruction would not be financially sound.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

A Haulage Problem.

Perhaps the following will assist "Inquirer" in his difficulty:—

5 miles per hour = 5×1,760×3/60 ft. per min. = 440 ft. per min.

Assuming the frictional losses amount to 12 lb. per ton weight, the total resistance will be 6×12 = 72 lb. Work done in overcoming resistance = (440×72) foot-pounds = 31,680 foot-pounds.

The load is raised 440×1/3.5 = 125.7 ft.

Work done in lifting the load = 125.7×6×2,240 = 1,689,408 foot-pounds.

H.p. = 31,680 + 1,689,408/33,000 = 1,721,088/33,000 = 52.1.

Assuming the gearing has an efficiency of 70 per cent. at full speed, the horse-power required = 75.

The motor and starter should be either one- or two-hour rated.

Robert Swindlehurst.

London, S.W.
February 13th, 1922.

The Stiffness of Poles.

In a letter published in your issue dated January 27th, Mr. Geo. V. Twiss states that the ratio of transverse to longitudinal strength of intermediate poles should be three to one, and in his penultimate paragraph seems to base his opinion on the assumption that the transverse load on the pole due to the wind pressure on the wires is approximately three times the load that would be thrown on the pole due to the breaking of one wire in three. In other words, the assumption is that the tension in the wire, after break has occurred, is about equal to the transverse load on the pole due to the wind pressure on the wire. It is seldom so, and there can be no fixed ratio because the two things are not even remotely connected.

To take a practical example: On the Clydach Vale-Duffryn-Rhondda line of the South Wales Electrical Power Distribution Co.'s system the conductors are .15 sq. in. and the maximum tension in each is 2,000 lb., but let us assume a reduced value of, say, 1,500 lb. to allow for a possible slipping of the broken wire through its binding and so forth.

On a 300-ft. span the transverse load due to three conductors is about 560 lb. (on the existing regulations—namely, 25 lb. per sq. ft. and a coefficient of 0.6 for rounded surfaces). On a 700-ft. span the transverse load is about 1,300 lb. and on a 1,200-ft. span about 2,230 lb. The ratio of transverse strength to longitudinal strength with one wire broken would, therefore, not be 3 to 1, but 3 to 8.02, 3 to 3.47 and 3 to 2.02, respectively.

In an ordinary case the presence or otherwise of an earth-wire and its position as well as the wind pressure on both faces of the tower would also have to be taken into consideration, but the above figures should be sufficient to show that in actual practice the ratio varies over wide limits, and is nowhere near the figure given by Mr. Twiss.

It would be interesting, however, if Mr. Twiss would give particulars of the lattice steel structures on the long spans to which he refers.

Charles W. Kay.

London, E.C.4.
February 13th, 1922.

I beg to refer to Mr. Gower Pimm's article in your issue of January 6th, and his letter (in reply to the views I gave) which appeared in your issue of February 3rd.

In recommending that intermediate poles should have a strength in the longitudinal direction of one-third that in the transverse direction, I mean a strength to carry the loads for which the poles are employed, *i.e.*, the loads due to wires, it being understood that the load inherent to the pole itself—*i.e.*, wind load on the pole—is already provided for.

In an endeavour to controvert my view Mr. Pimm makes reference to a total transverse load, half made up of the wind pressure on the pole, and half on the wind pressure on the wires. These two loads, however, are not "addable," and to equate a wind load which is distributed over the pole, to a load applied at the top, for the purpose of adding (and thereby getting a total transverse load) is fallacious, as I endeavoured to show on p. 423, Vol. 155, No. 256 of the "I.E.E. Journal."

There is also another fallacy in this connection which can be seen by reference to (2) of the further factors involved given below.

Mr. Pimm further endeavours to discount my proposal by considering its application with a span halved, and alternatively doubled. I would point out, however, that the span length of a properly-designed transmission line is not an arbi-

trary thing which can be halved or doubled at whim, but is a function of the size of conductor and the tension to which it is stressed, and that in turn the slip of a binder is also connected to the size of the conductor bound, so that there is a definite connection, in fact, between longitudinal and transverse stress on the pole.

The above rule which I have given and recommended is intended to be helpful, and has the advantage of being eminently simple and practical.

If, however, there are those who prefer to add to the existing considerable calculations necessary to correctly design a transmission line by further calculations such as Mr. Pimm proposes, by all means let them do so; but, in that event (as Mr. Pimm's method does not provide for them) they must have regard for further factors, amongst which are the following:—

1. Elasticity of the conductors themselves.
2. The fact that the maximum tension in the wire, and hence the load on the pole in the longitudinal direction, due to the wires, upon which the deflection calculation is based, can only be reached when the wires are subjected to a wind blowing transversely to the line; and, conversely, when the wind blows longitudinally to the line, thus putting on the pole the maximum load due to the wind itself, the load due to the wires is less than the maximum.
3. In the case of wood poles the commercial variation in (*a*) the sizes of wood, and taper of any given nominal size of wood pole, and (*b*) in the stiffness of any wood. In the case of steel poles the taking-up of manufacturing clearances in bolt-holes.
4. The movement of foundations due to the slight give of the earth itself, which is multiplied considerably at the top of the pole.
5. The variation in the slip of binders due to varying sizes of conductors, and how well the bind is made.
6. The entire alteration of the situation in the event of suspension insulators being used.

Many of these factors, however, though of considerable influence in the case, are not determinable with any degree of exactitude, which, in my view, discounts this method of calculation as a means of giving the required results.

Geo. V. Twiss, M.I.E.E.

London.
February 9th, 1922.

The Utilisation of Waste Heat.

I have read with much interest the letter signed H. E. Mitchell, which appeared in your issue of the 3rd inst., on page 157. I attended the joint meeting of the Institution of Electrical Engineers and the Institution of Heating and Ventilating Engineers on the 19th January, but, like the author of the letter, had no opportunity of taking part in the discussion. I agree generally with the views so clearly expressed by Mr. Mitchell, but differ from him regarding certain details. On entering a modern electric generating station one is struck at once with the evidences of evolution; at one end of the building will be seen old reciprocating sets now disused, and at the other end steam turbine sets, each having an output of anything from say 3,000 kW to 6,000 kW or higher. With these latter sets the temperature inside the condenser at a vacuum of say 28 in. to 29 in., may be about 90 deg. F., while the circulating water may have a temperature of 45 deg. F., at the inlet and 70 deg. F. at the outlet. All such temperatures are far too low to be of use in heating water to be circulated to adjacent buildings. Some steam turbines are provided with an opening through which they can be bled; in one such case the steam is available at 14 lb. absolute, that is 1 lb. below atmospheric pressure, and with a calorific value of about 1,070 B.th.u. above 80 deg. F. Such steam would of course be quite suitable for heating water to, say, 180 deg. F, or 190 deg. F. For the reasons above cited I venture to think that Mr. Mitchell's suggestion of using the ordinary steam turbine condenser for the public supply of hot water is impracticable. My suggestion is that the old disused reciprocating sets should again be brought into service and worked at a back pressure of anything between 2 lb. and 5 lb. gauge pressure, such steam either to be delivered to public mains, where hot water would not suffice, or to be employed in calorifiers for heating water to be circulated in public mains. Under such conditions electricity would be generated as a by-product; the charge for the exhaust steam, or hot water, supplied to consumers covering all the cost of running the plant.

E. R. Dolby, M.Inst.C.E.

Westminster.
February 7th, 1922.

Referring to the recent joint discussion at the Institution of Electrical Engineers, the writer, who was present at the meeting, ventures to make a few remarks on a phase of the question which does not appear to have received the attention it deserves.

I would lay stress on the fact brought out by Mr. Whysall in his paper, that electricity is the true by-product where low-grade heat is employed for heating buildings, or industrial purposes. To encourage the production and utilisation of this by-product, electricity, it is necessary that ready means should be available for its disposal. Such means are already existent in the network of distributing mains of the electricity supply undertakers, and I would submit that the Electricity Commissioners should devote their attention to the introduction of legislation to compel an electricity supply undertaking to purchase electricity, on stated conditions, from anyone in the district served by its network of mains. The price per unit to be paid should be, it is considered, the current cost per unit for generation by the supply authority obtained from its official returns. Users of low-grade heat on a large scale would thus be encouraged to install plant for generating electricity during the period when heat was required, to the ultimate benefit of the community in general and the electrical engineering profession in particular. The electricity thus produced would be at once absorbed in the supply undertaker's network with the minimum loss for distribution. The supply from an ordinary heating installation is at a maximum in the winter months, when the demand upon the electricity generating station is a maximum, and would thus tend to improve the load factor of the latter. Several instances have come under observation where electricity could thus have been delivered into a supply undertaker's mains with, it is believed, considerable benefit to both parties.

The idea thus set out is not novel, and there is believed to be a privately-owned hydraulic plant in North Britain which thus supplies its surplus energy to the local supply authority. The matter is revived in this connection, as it is considered that the necessity for conserving our supplies of coal, and furnishing a cheap supply of electricity for industrial purposes, is of such pressing urgency, that no avenue by which this goal may be reached should be left unexplored.

J. H. Fossett, B.Sc., A.M.I.E.E.

London.
February 2nd, 1922.
[Abbreviated.—EDS. ELEC. REV.]

Deposits for Specifications.

I should be glad if you could give publicity through your paper to the objection to the practice of corporation bodies asking for deposits on the specifications of their requirements.

In many cases the invitation to tender for these bodies is accompanied by a request for a two- or five-guinea deposit, in some instances returnable on the receipt of a bona-fide tender, but in several cases just recently my firm has forwarded the required fee, only to find on receiving the specification and tender forms that the terms of payment, or some other condition, make it impossible to tender.

In these days English manufacturers cannot afford to tender for plant when the payment is to be deferred, in some cases, for a period of six months or so after the delivery of the goods.

It is my opinion that if manufacturing firms and merchants would refuse in a body to even offer to tender when corporation bodies call for deposits, a great deal of annoyance would be avoided, and also expense—for when the cost of preparing an elaborate tender is added to a preliminary fee of anything from two to five guineas, the expense is considerable in those frequent cases when the terms preclude firms from submitting a tender in accordance with their customary conditions.

I should be glad to have other readers' views on this matter.

W. H. Pease, A.M.Inst.M.E., A.F.Aer. Inst.

London.
February 11th, 1922.

The Necessity for Skilled Workmanship.

I read with interest the article of Mr. "Voltman" in your issue of January 27th, and I personally welcome very much its appearance in your valuable paper, and feel that there is a necessity that the electrical trade, in general, should abandon its passive attitude in respect of electrical work, which is constantly being carried out throughout the country by so-called electricians, who in reality are plumbers and ironmongers, and handymen of every description.

Whilst the electrical industry has made gigantic progress, and whilst electricity is daily claiming the place which has been hitherto occupied by gas or any other power, there are still large numbers of people who maintain the idea that electricity is the thing of the future, and that meanwhile, so to speak, during the experimental period, the work they may require, such as the installation of a few bells, or a few lights, can be carried out by the ironmonger or plumber and gasfitter, or any lad who has read about electricity in a children's newspaper, and can do a little work when he is at home on his vacation.

I think it is time that the Electrical Contractors' Association, as well as each electrical contractor, made it their business to bring to the notice of the public the fact that electrical work, to be carried out properly, requires knowledge and skill, which most of the above-mentioned handymen lack, and, in addition, it is of vital importance that this work should be carried out in a safe manner, as lighting generally is supplied at a pressure between 100 and 240 volts, which is quite sufficient to cause unpleasantness in the form of shocks

and leakages, which are so generally found by an electrical contractor, when he is called in to remedy breakdowns with which the above-mentioned handyman has unsuccessfully battled for days.

While electricity is the safest and the most convenient means of lighting, heating, and cooking when the installation is satisfactorily carried out, it is as dangerous as gas, when the handymen fiddle about with it.

Parkstone, **E. Brontman.**
February 7th, 1922.

[Abbreviated.—Eds. Elec. Rev.]

Private House Lighting at 25 Periods.

In your issue of February 3rd, you print a very useful abstract of an address on "The Electrical Development of Outlying Districts."

The question of giving a supply for lighting at 25 periods is not favourably commented upon in this abstract, and is altogether ignored in the four schemes giving relative costs.

May I say that, after being many years in charge of an area supplying power and lighting at 25 periods, and moreover living in a private house with lighting at this frequency, the almost imperceptible "flicker" is really not noticed.

Granted, "flickering" does occur, but it is only troublesome under certain conditions, and the exercise of a little common sense is all that is needed to remove the trouble.

Roughly, the circumstances in which "flicker" is noticeable is when a lamp hangs over a bare white table cloth or drawing board, or in light rooms, such as a white bathroom.

In any case the trouble can be so modified as to be unnoticeable by well-chosen lamp positions, "frosted" lamps, indirect of semi-indirect lighting, and can be entirely eliminated by the use of carbon-filament lamps if absolutely necessary.

For all practical purposes, however, if the supply is available at 25 periods, there is no reason why distribution should not be carried out at that frequency. After all, the chief reason of the development of outlying districts is to give the public an "adequate and cheap" supply of electricity on commercial lines, and the conversion of electricity through rotary machines, apart from increased capital cost, entails standing charges which should be avoided at all costs in these schemes.

Pontypool (Mon). **Theo. R. Kernick, A.M.I.E.E.**
February 10th, 1922.

[It would be interesting to know whether the long-continued use of a frequency of 25 cycles resulted in any physiological effects on the eyesight. The flicker might be reduced by supplying electricity at a low pressure—100 or even 50 volts—or on the condenser system, which enables low-voltage lamps to be run in series; the thicker filaments thus made possible would no doubt undergo less fluctuation in temperature.—Eds. Elec. Rev.]

An Overworked Iron.

With further reference to the 100-volt electric iron which was used on a 200-volt circuit, and Mr. Davis's reply to my letter of the 31st ulto., it appears that your correspondent chooses to be rather more personal than precise in his remarks. However, after condensing the statement made by Mr. Davis, we are able to discover the "nigger" in this apparently "wonderful" performance, which is, that the current was only applied to the iron for a few minutes at any time, being switched off before becoming red-hot, all of which goes to prove that the performance was not in the least wonderful. In fact, any iron of well-known British make would have given the same, or quite probably better, results than that attributed to the iron in question.

Your correspondent states that an electric iron "is never in use continuously during ironing operations." The fact that an electric iron can be used continuously, is one of the prime arguments in favour of using electric irons in preference to any other, since they are usually designed and loaded in order to promote a saving in time and prevention of heat loss in the iron during the process of ironing. It is evident that if an electric iron is to be switched off every few minutes to prevent over-heating and burning of the material, ironing under these conditions would become not only laborious but extremely dangerous.

With regard to the supposed incorrect statements of loading and face area on which my calculations were based, I beg to remind Mr. Davis that the original article on this subject was devoid of any technical details, and some presumption was necessary in order to arrive at a concrete argument. The loading applied, however, to well-constructed irons of 4-5 lb. size, is approximately 400 watts. As to face area, I agree with him that this was probably incorrect, but the incorrectness was distinctly in his favour—the average face area of this size of iron being 18/20 sq. in., which would make the loading considerably more than 64 watts per sq. in.

It would be very interesting to know what electrical heating apparatus (other than water-heating appliances) is loaded to "64 watts per sq. in. and more."

London, W.9, **Wm. B. Scourfield.**
February 13th, 1922.

[Abbreviated.—Eds. Elec. Rev.]

Charging for Services.

In a recent issue of your paper the question of "charging for services" was raised by "A Contractor." It would be perhaps both useful and interesting to know on what basis the present usually excessive charges are made by many supply authorities in the London area for connection to their mains. Your own explanation and the information to be found in the "Electrical Contractor's Year Book" throw no certain light on this important issue. These charges vary considerably in different supply areas, and usually represent a considerable, very often a prohibitive, percentage of the total cost of installation, and are an undoubted hindrance to electrical development, particularly with potential domestic users—a class, the importance of which we have heard so much about recently!

Where service lines are required to be laid on partly public and partly private ground, as is usually the case for ordinary houses, or even shop premises, the writer has known cases quite recently where a few feet of the supply cable has cost the unfortunate potential consumer as many pounds and more in initial outlay. Nor does this cable even become the property of the consumer who has paid so dearly for it, but presumably in a few years' time it will be paid for again—by a grateful community!

In any case, if as is stated, up to 60 ft. is allowed free on public ground, there appears to be nothing to prevent the supply authorities from recouping themselves by charging any figure they care to for the remaining portion of the service line, which almost invariably terminates on private property! It would be enlightening to know if this is the case generally or whether there exist any regulations governing the charges for service lines laid on private property—in the interests of both the consumer and electrical development generally, so far as the smaller, but more numerous, class of installation is concerned.

W. A. Chambers.

London, W.C.2,
February 13th, 1922.

Electrically-heated Oil Filters.

I shall be pleased, and I feel sure quite a number of engineers similarly placed as myself will be grateful, to know of a lubricating oil filter heated electrically instead of by steam or hot water. We use Diesel and gas engines, and consequently have no steam available; heating coils placed round exhaust pipes make a clumsy job, as each engine has to be so treated for only a small filter, and hot water from either the vaporiser or circulating tank is also out of the question, as they are too far away, and long pipe lines are unsatisfactory.

I have seen filters placed near exhaust pipes, but in such a case you must either shift the filter from engine to engine or run the engine up. I have also seen them placed near the gas generator, but here dust is a great objection.

To me the only solution appears to be a filter heated electrically; the element can either be a sealed one, or one of the open type, but neither must come in contact with the oil in any way, and to do this the filter should be in two distinct parts, the one the filter proper, under which is the small heating element, and the other a receptacle to receive the clean oil.

Can anyone put me in touch with such a device, or one which will do the work equally well?

Filter.

February 8th, 1922.

A Distribution Problem.

I have read with interest Mr. W. J. U. Sowter's letter under the heading of "A Distribution Problem." Mr. Sowter may be interested to know that the Northwood Electric Light and Power Co. distributes single-phase a.c. on a three-wire system, but the supply received in bulk is three-phase. The system was previously d.c., three-wire, and the change-over was effected without any alteration of the distributors other than splitting the network into three separate sections, each fed by a feeder or feeders. The transformers are wound delta on the 3-phase high-pressure side, and on the low-pressure side the windings are arranged in three separate single-phase units, but by means of links the transformers can be star-connected for 3-phase 4-wire distribution if they should ever be required for that purpose. Of course it is obvious that each section of the network is supplied from one phase, and whilst interconnection of distributors is possible on that section it is not possible to interconnect the whole system. An approximate balance between phases has to be obtained, and in gaining this the network may have to be split up so that certain distributors, previously part of a ring main, now run to dead ends, with a consequent pressure drop. It will be seen that in order to obtain balance between phases and steady pressure on all sections the feeding points may have to be re-arranged, and additional feeding points provided. If Mr. Sowter is relaying a large section of his mains and sees a reasonable chance of obtaining a bulk supply, he would have an excellent opportunity to arrange his network with a view to splitting it up later on. Another method would be to distribute two-phase three-wire through Scott-connected transformers; in this case,

of course, the neutral would have to be of larger cross-section, and when the bulk supply was taken it would probably be necessary to relay the original three-wire mains.

Electricity Offices, Northwood. **H. Payn.**
February 13th, 1922.

In connection with the above subject and Mr. Sowter's recent letter in the Review, if the point he is mainly exercised upon is that of giving a three-phase four-wire supply, I would point out that such a supply may be given from a three-core cable, if a suitable static balancer is installed adjacent to the location of the load or loads to be supplied. The provision of such a balancer, which in the case of three-phase distribution should preferably be of the interconnected-star type, will allow a neutral connection to be taken from its star point for the purpose of providing a neutral for the l.p. distribution system. Clearly this results in a certain amount of saving, so far as cable costs are concerned, particularly when the question is one of changing over an existing distribution network. If it can possibly be arranged each balancer should be located so that a neutral wire can be derived for supplying several consumers as distinct from a balancer for each consumer, as by this means the total outlay on balancers is reduced.

I enclose herewith for your perusal, sir, and for Mr. Sowter, if you will be good enough to send it on to him, copies of a paper dealing with three-phase interconnected-star static balancers, and I trust these will be of some interest.

S. Austen Stigant,
Manager, Transformer Department,
Johnson & Phillips, Ltd.
London, S.E.7,
February 13th, 1922.

[Several letters have been held over owing to pressure on our space.—Eds. Elec. Rev.]

BUSINESS NOTES.

Bankruptcy Proceedings.—James Victor Figgins, electrical engineer, carrying on business at 3, Pottery Terrace, Alexandra Road, Newport.—The creditors met at Newport on February 9th. Debtor estimated his liabilities at £752 and his assets at £38. He attributed his failure to bad debts, loss on a contract, and strikes. He said that prior to joining the Army, in which he had served five years, he was a plumber at Portsmouth. In November, 1919, he started business at Newport as Figgins & Bridges, but since February, 1921, he carried on the business in his own name. The Official Receiver remains trustee.

A. C. Ince (formerly the Newcastle Electrical Engineering Co., now with a partner under the style of The Tyne Electrical Industries), electrical contractor, 21, Fenkle Street, Newcastle-on-Tyne.—Receiving order made February 6th on debtor's own petition. First meeting, February 22nd, at the Official Receiver's offices, Newcastle-on-Tyne. Public examination, February 23rd, at the County Court, Newcastle-on-Tyne.

F. A. S. Wormull (Lewisham Electric Wiring Co.), electrical engineer, 273, High Street, Lewisham, S.E.—Last day for proofs for dividend, March 1st. Trustee: Mr. T. Gourlay, 29, Russell Square, W.C.1.

V. B. Worthington, electrical and mechanical engineer, Ellesmere Yard, Walkden, Lancaster.—Last day for proofs for dividend, February 25th. Trustee: Mr. J. G. Grant, Official Receiver, Byron Street, Manchester.

M. Watkinson, H. Watkinson, and A. Watkinson (Watt and Co.), electrical and mechanical engineers, 22 and 24, Palmer Road, Sheffield.—Last day for proofs for dividend, February 25th. Trustee: Mr. T. C. Parkin, Junr., 36, Bank Street, Sheffield.

W. Hurworth and A. A. Watmough (Hurworth, Watmough & Co.), electrical engineers, 41, Town Street, Horsforth, and 1, Back James Street, Harrogate.—First meeting, February 23rd, at the Official Receiver's Offices, Leeds. Public examination, March 21st, at the County Court House, Leeds.

Company Liquidations.—Stockwell & Ohms, Ltd., electrical power contractors, 164a, Pentonville Road, London, N.—As briefly reported in our last issue, pursuant to Section 188 of the Companies (Consolidation) Act, a meeting of the creditors of the above took place on the 3rd inst. at the offices of Messrs. Waissen Wilson & Co., C.A., 2, Fenchurch Avenue, E.C., when the representative of Messrs. Crompton & Co. presided. A statement of affairs was submitted showing the position of the company as at January 13th, 1922, the date of the resolution for winding up. The liabilities amounted to £2,268, all due to unsecured trade creditors, while the assets were estimated to produce £468, and comprised sundry debtors estimated at £190; stock £257; plant and tools estimated to produce £10; furniture £10 15s. There was thus a deficiency disclosed of £1,800. Mr. Holmes (the liquidator of the company) stated that the company had only been in existence a comparatively short time, and the present position had been brought about simply in consequence of the drop in values and the falling market generally. The directors of the company were Mr. Mepsted and Mr. Hayward, while Mr. Stockwell was the managing director. It appeared that the managing director had given out contracts to Messrs. Crompton and Messrs. Siemens to the extent of £5,000 for machines, and the deliveries were to be arranged over a subsequent 12 months. From October, 1920, however, the market prices were continually falling, and to such an extent that it was impossible to realise the purchase price of the goods. In these circumstances the managing director asked the various creditors concerned to delay deliveries. Eventually it was found that the company could not go on, and the matter was brought to a head by Messrs. Siemens obtaining a judgment against the company for the amount of their debt. Mr. Osborne, who represented creditors, asked questions with regard to the deliveries made by certain creditors, and it was stated that the last balance sheet of the company was got out in October, 1920, and this showed a profit of £380. Asked as to the stock which was held, it was stated that this included various Siemens machines and a d.c. motor, while Messrs. Hurst had supplied two machines which they claimed were sold on sale or return. The sales of the business since October, 1921, had been £1,107, while the payments to creditors and other expenses of the business were £950. A considerable discussion ensued. In the result it was decided that Mr. W. Osborne (of Messrs. Corfield & Cripwell) should be appointed as joint liquidator with Mr. Holmes, with a committee of inspection consisting of the representatives of Messrs. Crompton & Co., the English Electric Co., and the General Electric Co. The following are creditors:—

	£		£
General Electric Co.	136	English Electric Co.	908
Siemens Bros.	25	English Electric and Siemens Supplies, Ltd.	60
Simplex Conduits, Ltd. ...	12	Marshall & Plumtree, Ltd. ...	40
Crompton & Co.	1,270	Tucker (J. H.) & Co.	30
Edison Swan Electric Co. ...	15		
Edwards (C. J.) & Son	21		

The Wilson-Wolf Engineering Co., Ltd., 172, Thornton Road, Bradford.—In pursuance of the provisions of the Companies (Consolidation) Act, the creditors of the above were called together recently at Tanfield Buildings, Hustlergate, Bradford. Mr. R. S. Dawson (the liquidator in the voluntary liquidation of the company) submitted a statement of affairs which disclosed ranking liabilities of £9,545. The indebtedness to the trade was £3,142, while there were cash creditors for £4,532, and the bank was interested for £1,850. There was also a fully-secured creditor for £4 11s. 1d., and partly-secured creditors for £259. The latter held securities valued at £239, thus leaving £20 to rank. The assets were estimated to realise £7,945, from which had to be deducted £535 for preferential claims, leaving net assets of £7,410, or a deficiency of £2,135. The assets were as follows: cash in hand, £23; plant and machinery, £4,210; fixtures and fittings, £126; patterns, £99; stock, &c., £2,990; book debts, £477; and surplus from fully-secured creditors, £20. The issued capital of the company was £6,003, and as regarded the contributories there was a deficiency of £8,138. It was pointed out that in addition to the capital the directors and their friends had subscribed £4,000 by way of loans. The deficiency account showed that on March 31st, 1919, there was an excess of assets over capital and liabilities of £309. During the year to March 31st, 1920, there was a loss on the trading of £2,181, while in the following year the loss was slightly in excess of £3,000. Between May 1st and October 31st there was a loss of £1,635, while since the latter date there had been a further loss of rather more than £600. The company was registered in 1906. The present position had been brought about by the moulders' strike and the coal strike. The creditors unanimously resolved to confirm the voluntary liquidation, with Mr. Dawson as liquidator, and appointed an advisory committee consisting of the representatives of Clement Talbot, Ltd., the Hoffman Manufacturing Co., Ltd., and the Concordia Electric Wire Co., Ltd.

Devon Hydro-Electric and Development Co., Ltd.—Meeting of members March 20th at 52, Queen Street, Exeter, to hear an account of the winding up from the liquidator, Mr. T. W. W. Melhuish.

Dissolutions of Partnership.—Geo. Mitchell & Co., electricians, Market Bridge Mill, Burnley.—Messrs. G. Mitchell, F. S. Myers, and D. Roscoe have dissolved partnership. Messrs. Mitchell & Myers will attend to debts and continue the business under the same style.

W. H. Inman, electrical engineer, 38 and 40, North Road, Lancaster.—Messrs. W. H., J. E. and D. Inman have dissolved partnership. Mr. W. H. Inman will attend to debts and continue the business.

F. Watson & Co. and Advance Electric Lamp & Accessories Co., electrical engineers and electrical factors, 11, Northumberland Alley, E.C.—Messrs. F. Watson, G. P. Watson, and G. Bennett have dissolved partnership. Debts will be attended to by Messrs. Watson & Bennett.

Hurlingham Electric Co., electrical engineers and contractors, 283, New King's Road, Fulham, S.W.—Messrs. P. Walker and F. C. Ferrier have dissolved partnership. Debts will be attended to by Mr. Walker, who will continue the business under the same style.

Marsh & Sanderson, electrical engineers and contractors, &c., Station Road, Ossett.—Mr. A. H. Marsh and Mr. J. W. Sanderson have dissolved partnership. Mr. Marsh will attend to debts and continue the business in his own name.

Dyson & Ogden, electrical engineers, 16, Savile Park Terrace, Halifax.—Messrs. L. Dyson and H. Ogden have dissolved partnership.

Heath, Richardson & Co., electrical, motor and general engineers, auctioneers, and valuers, Wood Street and Bawtry Road, Doncaster.—Messrs. L. J. Heath, A. C. Richardson, and L. Ketley have dissolved partnership. Debts will be attended to by Messrs. Bell & Watson, accountants, 2, St. Sepulchre Gate, Doncaster.

Trade Announcements.—Messrs. Simplex Conduits, Ltd., have completed arrangements for a joint sales service with their associate company, Messrs. Credenda Conduits Co., Ltd., whereby all Simplex and Credenda productions will be available throughout the branches and depots of both companies. The arrangement is essentially one of sales organisation, but as such it deals only with actual productions of the companies, leaving untouched the usual factored lines in which each will continue its own course of action as before. The manufacturing policy of neither company will be affected. Apart from the chief common manufacturing of conduit, conduit fittings and wiring accessories, the two companies will continue to produce the following:—

Messrs. Simplex Conduits, Ltd.—Water-tight fittings and ironclad distribution boards, switch and fuse gear, enclosed fuses and fuse wires; colliery lighting units and industrial lighting fixtures; malleable and grey iron castings; electric lighting fixtures and illuminated signs.

Messrs. Credenda Conduits Co., Ltd.—Domestic electric heating and cooking appliances, ship, tramway and railway carriage electric heating units; heating elements for scientific purposes.

Mr. G. S. Thomas, having started business at Oswestry, Salop (his address is 10, Beatrice Street) desires to get into touch with firms marketing small self-contained electrical machines, such as coffee-mills, sausage-cutters, ice-cream freezers, hair-dressers' appliances, &c.

The business of Messrs. F. J. Shenton & Co., Ltd., has been purchased by a new company, which will carry on under the same management and staff with the title of Shenton and Co., Ltd.

Messrs. Smith, Roberts & Co. have commenced business as electrical engineers at Horsmonden (Kent).

Messrs. Higgs Bros., of Sand Pits, Birmingham, inform us they are shortly opening a branch at 84, Albion Street, Leeds, to deal with all the sales in Yorkshire.

The London Factors & Agents, Ltd., 39, Parliament Street, London, S.W.1, announce that their registered cable address is "Lonfacgent, London," and for inland telegrams "Lonfacgent Parl."

Messrs. A. V. Willmott, Son & Phillips, electrical engineers, &c., 124-127, Minories, E.1, notify us that they have been appointed sole British agents for Messrs. Nestler & Co., Ltd., of Briesen, Czecho-Slovakia, for all kinds of porcelain insulators.

Messrs. Ferguson, Pailin, Ltd., of Manchester, inform us that the Midland Counties district office has been removed from Guildhall Buildings, Navigation Street, Birmingham, to Daimler House, Paradise Street, Birmingham. Telephone number: Midland 2394.

The Victor Manufacturing Co. (H. F. Beaty & C. E. Swallow), informs us that it is to be wound up, and will cease to carry on business after February 18th.

Catalogues and Lists.—The Heavy Current Electric Accessories Co., Park Road, Edmonton, N.9.—A trade price list of switches, switch-plugs, wall-plugs and sockets, and connectors. Illustrated.

The Enterprise Manufacturing Co., Gun Street Electrical Works, Bishopsgate, E.1.—Current price list, for February, of electrical accessories.

The Damard Lacquer Co., Ltd., Warwick Road, Greet, Birmingham.—A pamphlet advertising "Damard" and "Damarda" lacquers.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.—Leaflet No. O 2693, illustrating and describing the "Handilite" flash lamp, containing a small dynamo. Leaflet No. 2676, giving a list of revised prices of automatic circuit breakers.

The Victory Pipe Joint Co., Ltd., 28, Victoria Street, S.W.1.—An illustrated price list of "Victaulic" pipe joints for pipes of from ¾ in. to 72 in. diameter.

The Hart Manufacturing Co., 76/77, Rochester Row, Westminster, S.W.1.—A well-illustrated and fully-priced catalogue of "Diamond H" switches of various patterns, push-button plates, &c.

Mr. H. W. Sullivan, 368 and 369, Winchester House, E.C.2.—New illustrated price list (W 3) of apparatus for wireless transmission and reception, including condensers, inductances, oscillation transformers, coupling coils, tuning circuits, &c.

Cheltenham Works, Ltd., 86, Acre Lane, Brixton, S.W.2.—An illustrated list describing several types of "Reimac" and "Super-Relm" lathes.

Sloan Electrical Co., Ltd., 8-12, Golden Lane, E.C.1.—An illustrated and priced list of electric lighting fittings made by Messrs. Peyton & Peyton, Ltd., of Birmingham, for whom the Sloan Co. is the London district agent.

The General Accessories Co., Ltd., 125, High Holborn, W.C.1.—A well-illustrated price list of electrical accessories, including switches, lampholders, adapters, bell pushes, ceiling roses, fuseboards, &c.

Michell Bearings, Ltd., South Benwell, Newcastle-on-Tyne.—A new edition of "The Michell Bearing Book," giving notes on the principles of scientific lubrication and illustrations of the construction of Michell bearings, with full description.

Westinghouse Electric International Co., East Pittsburgh, Pa., U.S.A.—Price supplement for general catalogue, dated January, 1922.

Messrs. Marshall & Plumtree, Ltd., 20, High Holborn, W.C.1.—An illustrated and priced leaflet describing the "Granta" testing set.

Electrical Conduits, Ltd., Anchor Works, Birch Street, Walsall.—List No. 50, giving prices of conduits and conduit fittings of numerous types, including connector boxes, switches, and ceiling rose fittings.

The Consolidated Pneumatic Tool Co., Ltd., Egyptian House, 170, Piccadilly, W.1.—Circulars No. 74, dealing with the "C.P." rock drill; No. 75, describing the "Little Giant" hammer drill; No. 76, giving an illustrated description of "C.P." electric welding plants; and No. 77, relating to "Class N" self-oiling steam and belt-driven air compressors.

Automatic & Electric Furnaces, Ltd., 281 & 283, Gray's Inn Road, W.C.1.—An illustrated leaflet giving particulars of a method of heating incubators by electricity.

Mr. Charles Mayfield, 3, Duchess Road, Clifton, Bristol.—A typewritten circular advertising a magneto flash lamp.

Our Foreign Trade.—January Figures.—The following were the values of imports and exports of electrical goods and machinery during January, 1922:—

	January, 1922.		Inc. or dec.
Imports—	£		£
Electrical goods and apparatus ...	111,710	–	130,933
Machinery	7,522,396	–	1,037,219
Exports—			
Electrical goods and apparatus ...	802,209	–	492,689
Machinery	5,799,824	–	2,260,440
Re-exports—			
Electrical goods and apparatus ...	12,165	–	18,333
Machinery	68,458	–	64,974

Workmen's Compensation.—The Executive of the Miners' Federation met the Home Secretary on February 9th, when it made a request for new legislation for workmen's compensation, embodying the recommendations made in the Holman Gregory report. The special legislation passed during the war increasing the amount of the total disablement allowance in consequence of the increased cost of living expires at the end of the present year. The miners therefore asked, as an alternative, in the event of the Government's not dealing with the recommendations of the Holman Gregory report, that there should be a short Act passed continuing the payments to disabled persons at the present level. The Home Secretary, in reply, admitted that steps would have to be taken to get an agreed measure through the House this year, because of the fact of the expiration of the war legislation. He invited the Federation to submit proposals to him which might assist in getting a measure before the House of Commons on which there would be substantial agreement.—*Daily Telegraph.*

New India Company.—A new concern has lately been formed at Naosari (Baroda) with a capital of 5,000,000 rupees, and the title the Naosari Electric Supply Co.

Swedish Locomotives for France.—It is reported that the Allmänna Svenska Elektriska A.B., of Vasteras, has succeeded in concluding a contract for the delivery of 30 electric locomotives to the French State Railways. If the report is correct a French contemporary states that it is regrettable that the State Administration has placed a relatively important order abroad while the French industry is in a state of atrophy. As compared with this statement, it was recently announced that the syndicate dealing with the electrification of railways (Schneider-Thomson-Houston and Jeumont group) was on the point of entering into a contract for 80 electric locomotives and 80 motor-coaches to be supplied to the Paris-Orleans Railway Co.

Rating of Machinery.—A Bill has been presented by Sir James Remnant in the House of Commons to amend the law relating to the rating of machinery; it provides that only fixed machinery shall be valued for rating purposes.

Patent Restoration.—An order has been made restoring patent No. 19,851, of 1910, granted to Alphonse Constante Reyrolle and A. Reyrolle & Co., Ltd., for "Improvements relating to electrical cut-outs."

London Electricians' Wages.—In accordance with the national wages agreements entered into between the N.F.E.A. and the E.T.U., which were abstracted on p. 194 of our last issue, the wages of electricians in London were reduced from 2s. 3d. to 2s. 1½d. per hour as from the second pay-day in the present month. This rate remains in force up to and including the first pay period of June next. The rate for "auxiliary workman assisting electrician," being 80 per cent. of the rate paid to fully-qualified journeymen, is reduced to 1s. 8½d. an hour.

Lead Report.—Messrs. James Forster & Co., in their report of February 11th, state that closing prices on February 10th were £20 15s. for February and £20 12s. 6d. for April, against £21 5s. for both positions at the end of the previous week. "Imports into London and Liverpool only, last month amounted to 14,500 tons, and the total for January will probably be about 17,000 tons. This month will show a much reduced quantity, but probably sufficient for the existing indifferent trade conditions."

An Edinburgh Exhibition.—The many uses to which electricity can be put in the house will receive practical illustration at an Ideal Homes, Housing, and Health Exhibition, which is to be opened on the 20th inst in the Waverley Market, Edinburgh. All the latest labour-saving devices will be on view, the exhibitors including the Corporation Electricity Department, the Edinburgh branch of the E.C.A., and a number of well-known electrical firms.

Unemployment and Health Insurance.—A joint committee has been appointed by the Ministries of Health and Labour to consider the possibilities of bringing the unemployment and health insurance schemes under one administration.

For Sale.—Assets Auctions Co., Ltd., will sell by auction, on February 22nd, at 119-121, Newington Causeway, drilling machines, forge blowers and electrical accessories, conduit, fittings, &c. (See our advertisement pages to-day.)

The British Industries Fair, 1922.—This year's fair, which opens on February 27th, will be divided into two sections only instead of three as last year, the attendance at the Glasgow (textiles) section having been considered insufficient to justify its continuance. The London section will be devoted, more or less wholly, to "fancy" goods and the smaller articles of commerce. The Birmingham section, which is of the greater interest to our readers, is again being held at Castle Bromwich Aerodrome, and a large number of engineering firms are participating. A more detailed reference to this matter will be made in our next issue.

Copper and Lead Prices.—Messrs. F. Smith & Co. report February 14th:—Copper (electrolytic) bars, £68 10s., £3 15s. decrease; ditto, ditto, sheets, no change; ditto, ditto, wire rods, £85 10s., 5s. decrease; ditto, ditto, h.c. wire, 10½d., ¼d. decrease; silicium bronze wire, 1s. 2¼d., ¼d. decrease.

Messrs. James & Shakespeare report February 15th:—Copper bars, sheet and rods, £92, £2 decrease; English pig lead, £21 15s., 15s. decrease.

The German Electrical Industry.—The trade reports issued monthly by the Prussian Chambers of Commerce, which showed a decline in the amount of new orders booked in December, now record a further diminution for the month of January. At the same time it is said that the old orders on hand will provide work for a long time forward.

Works Committees.—At a recent meeting of District Council (No. 2) Electricity Supply Industry (Yorkshire, &c.), it was reported that the two sides had agreed to co-operate to secure the formation of Works Committees in undertakings not already possessing them, on the lines of a "model constitution" formulated by the National Council. Trade Unions and electricity undertakings are being communicated with on this matter.

An Industrial Appliance Exhibition.—During last week the General Electric Co., Ltd., devoted a showroom at Magnet House, Kingsway, to a display of apparatus and appliances necessary to efficiency in industrial establishments, &c. The term "industrial" was given a broad interpretation which admitted a number of things not usually classed under that head. The display possessed the quality of variety. Numerous lighting fittings, such as lanterns, flood-light projectors, and ship's lighting equipment, were shown, as well as a colour-matching unit fitted with two "Osram" gasfilled lamps, one blue-tinted. There were electrically-heated towel rails and hot-water radiators fitted with immersion heaters, sealing wax heaters, and sterilisers for surgical instruments. Samples of pedestal switchgear and of standard dockyard plug boxes were included. Two watertight lamp fittings which had been immersed in water for at least six months were demonstrated to have justified their name. A large range of "Witton" fractional-h.p. motors appeared, and "Witton-Kramer" portable, bench, and post drills were exhibited and their powers demonstrated. Applications of the motors to grinding, polishing, and buffing machines were also shown. The other exhibits included telephones, cookers, accumulators, electric muffles, &c.

Engineering Exhibition at Liége.—The *Board of Trade Journal* announces that an International Technical Exhibition of Engineering will be held at Liége during June and July under the auspices of the Association des Ingénieurs de l'Ecole de Liége. The exhibits will include machines and equipment, instruments, models, books, plans, diagrams, and all documents relating to engineering. Applications for space should be addressed to the secretary, 16, Quai des Etats-Unis, Liége.

Book Notices.—"Lockwood's Builders' and Contractors' Price Book, 1922," 776 pp. London: Crosby Lockwood and Son. Price 7s. 6d. net.—The Electrical Section of this comprehensive work has been brought up-to-date and enlarged. Some notes comparing pre-war and post-war costs of electrical installations are included. A number of typical cases are taken and the probable cost of installation and maintenance is given in detail. As an example of the general conditions to be complied with in wiring premises, those used by the City of London E.L. Co., Ltd., are reproduced. Electric lamps are dealt with fully, and notes on radiators, cooking apparatus, &c., also appear, as well as information regarding motors, conduits, accumulators, and intercommunication telephones.

"The Technology Reports of the Tôhoku Imperial University," Vol. II., No. 3, 69 pp. Tokio and Sedan: Maruzen Co., Ltd.—This issue comprises five papers, including "The Modulation Control of Radio Telephony," and two papers on "The Dynamic Methods of Determining Triode Valve Constants."

We have received a prospectus of "The Dictionary of Applied Physics," which is being published by Messrs. Macmillan and Co., Ltd. This outlines the scope of the work and gives a list of well-known physicists who have contributed notes and articles.

"The Ventilation of Electrical Machines," by R. Roberts (24 pp.). New Malden: Vizetelly & Co., Ltd. (for the Association of Engineering and Shipbuilding Draughtsmen).—This paper deals with various methods of ventilating motors and generators, and gives numerous curves and calculations bearing on the subject. We have also received lists of reprints of papers and lectures read and delivered before the Association.

"Central Station Voltages and Charges" (46 pp.). London: S. Rentell & Co., Ltd. Price 1s. net.—This is a pocket directory of electricity undertakings in London and the provinces (reprinted from the "Practical Electrician's Pocket Book"), giving numerous details, such as voltage and type of supply, engineers' names, and charges for energy for various purposes.

"Electric-power Load Curves" and "Electric Power for Milking Plants," by L. Birks, B.Sc.; and "Annual Rainfall Fluctuations," by L. Birks and D. C. Bates. Wellington (N.Z.): Marcus F. Marks, Government Printer.—These are reprinted papers from the New Zealand *Journal of Science and Technology*. Mr. Birk is chief electrical engineer of the New Zealand Public Works Department.

"Research in Industry," by A. P. M. Fleming and J. G. Pearce. Pp. xvi+244, 30 figs. London: Sir I. Pitman and Sons, Ltd. Price 10s. 6d. net.

"Continuous Wave Wireless Telegraphy," by B. E. G. Mittell. Pp. xv+114, figs. 58. London: Sir I. Pitman and Sons, Ltd. Price 2s. 6d. net.

"Electrical Engineer's Pocket Book," second edition. London: International Correspondence Schools. Price 10s. 6d.

Railway Power Station Employés' Wages.—A mass meeting of engineers employed in electric railway generating stations and sub-stations, and belonging to the National Union of Railwaymen and the Electrical Trades Union, held on February 8th, ratified the provisional agreement with the railway companies. The original demand of the companies for a reduction of 12½ per cent. in wages had been withdrawn, and it was agreed that the sliding scale arrangement, under what is known as the No. 10 Joint Industrial Council Award for the Electricity Supply Industry, should become operative. The effect is that, instead of suffering a reduction in wages of from 12s. to 14s. per week, the men will lose 6s. per week, arrears being wiped out at the rate of an additional 4s. spread over the nine weeks, and thereafter their wages will be governed by the cost of living, and adjusted three months later.—*The Times.*

Chinese Notes.—Wang Kse-tsing and others of Hyiao Feng district, Chekiang, propose to establish an electric light company.

C. C. Nieh, Lu Er-kia and other Shanghai merchants propose to organise the Yeh Chung Machine Manufacturing and Engineering Co., in Shanghai for manufacturing electric fans, electric lamps, dynamos, motors, and all other machines. Its capital will be $300,000 in 3,000 shares of $1,000 each.

The Ta Tung Co., Ltd., has recently been organised by Chang Chien, Jr., and others, with a capital of $1,000,000 at Garden Road, Tungchow. The company which is to specialise in engineering and electricity, was formally opened on December 15th.

An electrical material company has been organised at Shihchiachwang, Shihli, by the local Chamber of Commerce, with a capital of $2,000.

The Yang Lu Electric Light Co., of Kiukiang, Kiangsi, has been registered with the Ministry of Agriculture and Commerce.

The Peking Electric Light Co., Ltd., has contracted with a British firm for the purchase of a 5,000-kW generator for its new power station at Shihchinshan.

The Haiming Electric Co., of Kiangsu, has been registered by the Ministry of Agriculture and Commerce.

The Ming Yuen Electric Light Co., though in name under Chinese administration, is a Japanese capitalised firm. The users of its electricity number 3,000.

Electrical Imports into Spain.—During the first ten months of 1921 Spain imported the following material for the electrical industry, the second column showing the quantity imported from Germany:—

	Weight in kg.	Weight in kg.
Dynamos, motors, induction coils, transformers, and regulators up to 100 kg. ...	1,229,764	597,308
Ditto, from 100 to 400 kg.	1,094,698	538,039
Switchboards and switches up to 400 kg. ...	160,585	96,285
Dynamos, motors, switchboards, &c., from 401 to 2,500 kg.	2,590,484	964,943
Ditto, ditto, from 2,501 to 5,000 kg.	455,271	236,787
Ditto, ditto, from 5,001 kg. upwards	930,729	164,821
Total ...	6,461,531	Total 2,598,183

Great Britain sent 770,313 kg. and the United States 1,428,210 kg.; both increases compared with 1920, while the imports from Switzerland totalled 384,106 kg.—*Reuter's Trade Service* (Madrid).

Battery Locomotives.—The Electromobile Co., of Otley, has recently secured an order for a battery locomotive from the Glasgow Corporation. This will be one of the firm's No. 3 type machines capable of dealing with 30-ton loads and fitted with two single-geared motors. The speed on the level is six miles per hour and the battery capacity is sufficient to give a radius of from 20 to 25 miles per hour on ordinary service. An example of the firm's No. 1 size locomotive, which is a single-motor, chain-driven machine, has just been put into service by the South Essex Water Works Co. for tunnelling purposes.

The British Empire Exhibition.—Owing to its wide scope and the time required for its preparation, the British Empire Exhibition, which was to have been held next year, has been postponed until 1924. The decision was arrived at after suggestions received from India and other parts of the Empire.

Sale of the Alby United Carbide Factories.—At the foreclosure sale last week of the Alby United Factories at Odda, the Tyssefaldene Co. bought the factories for 50,000 kr. It was stated on December 1st that the purchasers were owed a large sum of money by the Alby Co., and that the Tyssefaldene Co., together with the English syndicate, to which the director-general of the Tyssefaldene Co. had transferred his interests, would restart the factories within six months for the production of ammonium sulphate.—*Reuter's Trade Service* (Christiania).

The Johannesburg Strike.—The strike of the Rand miners continues, although many men have returned under Government protection. On February 8th the Industrial Federation decided against a general strike. The Government, on the 12th, decided to prohibit picketing, and *Reuter* announced the arrest of 50 pickets on the following day.

Industrial Welfare.—Dr. D. A. Coles, chairman of the Medical Committee of the Industrial Welfare Society, says that his Committee has been requested by many firms to suggest a suitable form for the use of medical officers when examining employés. He asks for suggestions from those acquainted with this work.

A Supply Company's Order.—In the House of Commons on February 9th, Mr. Godfrey Locker-Lampson asked the Minister of Transport whether he had made an order increasing the maximum price to be charged for electricity by the North Metropolitan Electric Power Supply Co. in Southgate to 8d. per unit, for a period of five years, without a public inquiry. Mr. Arthur Neal, replying, said that objections made by the Southgate Urban District Council and the County Council of Middlesex had been considered, and the Minister had decided to exercise the powers vested in him by Section 32 of the Schedule to the Electric Lighting (Clauses) Act, 1899, and allow the increased charges without putting the public to the expense of an inquiry. The charge of 8d. a unit was allowed under the temporary order, which would have expired in August, 1923; he considered the charge reasonable.

Electrification of London Railways.—At a dinner attended by members of the House of Commons on February 13th the question of the electrification of railways in the London area was considered. It was decided to hold a meeting of the Industrial Group of the House of Commons on Monday next to give further consideration to the matter. The importance of the question may be understood from the fact that it involves an outlay of £17,000,000 extending over three years, which means the employment of 20,000 skilled men for the whole of that period.—*Daily Telegraph.*

E.D.A. Annual Luncheon.—We are informed that it has been necessary to revise the time fixed for the above function in view of the Commemoration Meeting of the Institution of Electrical Engineers taking place in the afternoon of the same day. The luncheon will take place at 1 for 1.15 p.m. on February 22nd.

Insulating Materials for Canada.—A Canadian company (whose name can be obtained by United Kingdom manufacturers from the Department of Overseas Trade) desires to receive quotations, samples, &c., for the supply of cotton tapes; pressboard or pressspahn; flexible sheet mica; red and black fibre sheets and tubes; and oiled cambric cloth and tapes.

Trade Terms and Conditions.—The E.D.A. recently convened an informal meeting between representatives of the principal associations within the electrical industry; this meeting took place on the 13th at the Engineers' Club, and was well attended. Some of the more important commercial issues between the different branches were discussed freely, and although the proceedings were naturally of a private character, we are permitted to say that the representatives went away with something of interest to report to their Associations, and there is reason to believe that negotiations now in progress will be assisted by the interchange of views which took place.

It is also possible that this conference may be followed by others of a similarly joint character, and it is hoped that problems which may occasionally be beyond the "give and take" limits of a purely sectional meeting will appear less difficult after they have been examined in relation to the industry as a whole.

This method of handling the more obstinate difficulties will increase understanding and sympathy between the several groups, which, after all, must, to enjoy individual success, achieve a common end.

Social Events.—Messrs. Pritchett & Gold and E.P.S. Co., Ltd., held a very enjoyable social evening on February 8th. The vocal and musical talent of the staff provided a really excellent programme, which included dancing. The outstanding feature of the evening was the presentation of a silver rose bowl to Sir Archibald and Lady Gold in celebration of their silver wedding by Mr. C. R. D. Pritchett, managing director of the company. Sir Archibald Gold, in thanking the company, referred to the late Mr. G. E. B. Pritchett, and said he had found it hard to carry on the work of the late chairman, who was a brilliant business man with great foresight and gifts far above the ordinary person.

Mr. George Ellison informs us that P. Jones, a former employé of his, made his *début* as a professional footballer on February 8th, playing for Aston Villa against Everton.

Private Arrangement.—Frederick Charles Goss, electrical engineer, 64, Gloucester Road, Bishopston, Bristol.—The creditors of the above, were called together in Bristol a few days ago, when a statement of affairs was presented, which showed liabilities of £1,221, all of which were due to the trade. The assets were estimated to realise £339, from which had to be deducted £15 for preferential claims, leaving net assets of £324, or a deficiency of £897. The assets consisted of stock at cost, £222, expected to produce £150; book debts, £48, valued at £40; cash in hand, £14; furniture, £75; and motor-car, £60. There were also fittings, fixtures, and utensils amounting to £22, on which no realisable value was placed at the moment. It was reported that the debtor started in business in partnership with another with a capital of £50. The partnership was dissolved in October, 1919, and a little later the debtor started on his own account with a borrowed capital. The present position was attributable chiefly to the general slump in trade. The drawings had been about £6 a week. An offer had been received for the purchase of the stock, motor-car, and furniture for £200. The matter was discussed at some length, and eventually it was decided that attempts should be made to obtain a better offer and one which would enable a composition of 4s. in the £ to be paid. Failing such an offer being forthcoming, the opinion was expressed that the matter should be dealt with in bankruptcy. The following are creditors:—

	£		£
Wholesale Fittings Co., Ltd. ...	47	Petters, Ltd.	37
Newtons	82	Graham, J. H.	13
Kear	16	Simpson, Baker & Co.	463
Macintosh Cable Co.	28	Bussells	137
Edison Swan Electrical Co., Ltd.	36	London Lamp Co.	23
Metropolitan-Vickers, Ltd. ...	52		

Electrical Supplies in Belgium.—The *Eclairage et Force Motrice* gives the following account of the trend of business in electrical supplies: In Belgium the figure of business in the twelve months just passed was below the normal as regards machines and electrical equipment, at the same time that German competition caused a lessening of sales of all articles, both imported and Belgian. The commercial attaché of the United States at Brussels reports that dynamos and generators from Germany were being sold at half the price of those coming from America and 20 per cent. less than those supplied by Belgian firms. Insulated wires and cables were being offered by a Charleroi firm at quotations much below those of American firms. The same might be said of the supplies for inland wire networks, and here also German competition was keenly felt. The use of arc lamps for lighting is of relatively small extent in Belgium, and it is rare to meet with the mercury vapour lamp. The commercial attaché adds that, owing to the lack of Belgian glow-lamp works, a vast business was being done by Dutch companies selling the metal-filament lamp. Nevertheless, some Belgian firms were now taking up, with American help, the manufacture of this class of goods in Belgium. A considerable movement had also been started in favour of the adoption of a well-known American make. German glow lamps were sold in great quantities in Belgium. The various measuring instruments of American manufacture

likewise suffered from the intensity of competition both from Belgian and German firms, prices being in the same proportions as those for machinery. Thus the Germans who tendered for the supplies to one of the big Brussels communes quoted 50 per cent. lower than American firms. As regarded motors, the principal American firms had had built, by Belgians with whom they were associated, types of a power up to 15 h.p., and the same was the case with small transformers. Good business was also being done in switchboard equipments; these formed, with high-pressure circuit-breakers, the most active objects of demand in this industry. In a general way Belgian purchasers of electric apparatus pay regard, more than do the Americans, to a fine outside finish, and are less exacting with regard to the working of the inner parts. An increase is to be noted in the demand for vacuum cleaners and electric irons; the former are, for the most part, of American manufacture, although there can be seen, in certain shops, similar French copies. Although many French, Italian and Swiss firms, making small electric cooking outfits, have agents in the principal Belgian cities, these articles have not yet attained to any remarkable vogue, owing to a lack of commercial aptitude and rational methods of publicity. Small electric tea kettles sell retail at 110 to 130 fr. Electric plate heaters, to keep warm three or four dishes, are quoted at 275 fr. A considerable demand has been created for small electric heaters suitable for use with the voltages usual in households. It seems that the one for which the greatest preference is shown is either the radiator type of heater or the lighthouse type, more often of French, Italian or Belgian make, and sold from 125 fr. upward according to size. There is practically no demand in Belgium for electric wringers and washers, or for electric fans. There is no general voltage in Brussels, since each commune has an independent lighting installation. As for Brussels city, a pressure of 110 volts is adopted, while the neighbouring commune of Ixelles uses 220 volts.

The Swiss Electrical Industry.—The *Exportateur Suisse* has the following on the Swiss electrical industry:—Compared with other industries, the manufacture of electrotechnical products is that which, in all countries, has been able to withstand the crisis longest. The call for electrical machinery for the equipment of new electric stations has created numerous orders for the electrical industry. Even in England the export of electrotechnical articles has undergone considerable increase in late months. Nevertheless, the continuous spread of the crisis, together with the advantageous offers from countries with depreciated currency, have gradually brought the electrotechnical industry of the whole world into a difficult position. The Swiss electrotechnical industry in late months has had, likewise, to record a shrinkage in its exports. The figures at present available are those for the first six months of 1921, and do not yet show the unfavourable influences on the exports apparent in the third quarter. The exports of the principal electrotechnical articles during the years 1920 and 1921 are as follows:—

	Fr., 1920.	Fr., 1921. Ha.f-year.
Other electrical instruments and apparatus	13,067,000	7,435,000
Measuring instruments and meters ...	12,676,000	6,085,000
Dynamos	41,409,000	22,083,000

The first market for Swiss dynamos, transformers, electric motors, &c., is constituted by France (1920, 13,500,000 fr.; first half-year 1921, 4,500,000 fr.). Notwithstanding this favourable showing, a fall back is still to be noted in the exports to this destination.

Other important purchasers of Swiss electrical machines were:—In 1920: Spain (6,600,000 fr.), Holland (5,800,000 fr.), Belgium (3,500,000 fr.), England, Scandinavia and South America, each with 1,600,000 fr.; Italy and Dutch Indies, 1,200,000 fr. each. The exports of the first half of 1921, taken together, show little variation compared with the foregoing year. The lower value of the exports to France was compensated for by the rise in the exports to Japan, Dutch Indies, Norway, &c. These countries also provided the most important outlets for Swiss measuring instruments, electric meters, and electric apparatus. From the above table it will be seen that these articles figure for large amounts.

Apart from the two firms which rank as the greatest in the Swiss electrotechnical industry—the Brown, Boveri Co., of Baden, and the Ateliers de Construction Oerlikon, of Oerlikon—which build the biggest dynamos, motors, and electric transformers—there are in Switzerland about 80 other firms which specialise in electric meters and measuring instruments, electric apparatus for high-pressure current, electric heating and cooking apparatus, weak current apparatus, installation material, &c. These firms employ about 8,000 workmen. . . . As to the future of the Swiss electrical industry in the world's market, account may be taken of the following considerations:—(1) From the standpoint of quality, efficiency and security of working, Swiss products enjoy the best reputation in the markets of the world; (2) the world's call for apparatus in the near future will be such as to be impossible of satisfaction by the other countries alone; (3) exports for the present are hampered by the political and economic insecurity which prevails generally, as well as by the lessened call for goods and the competition of countries with depreciated currency. There are critical periods when the industries of every country suffer, and which only disappear gradually. As to the low prices quoted by German industries, there is reason to believe that the recent depreciation of the mark has produced such a state of uncertainty in German business and production circles that the cost of manufacture, even in that country, has begun to rise. Hence a more reasonable adjustment of German prices with those of the rest of the world will become inevitable, and, as a consequence, Swiss products will soon be able to cope with the competition.

Electrical Developments in Australasia.—The Victorian House of Assembly has agreed to a Bill authorising the Lawson Ministry to borrow £2,000,000 for the purposes of works and undertakings of the State Electricity Commission of Victoria. It was stated recently that practically all tenders for the larger sections of the electricity scheme had been awarded. Referring to the acceptance of an English tender for £282,000 for the supply of boilers, for which twelve quotations were received, the treasurer stated that there was a difference of £87,000 between the price of the accepted tender and that received from leading provincial works in Victoria, after allowing for 40 per cent. duty on the imported machinery. The view of the Electricity Commissioners, he added, was that if they were required to give the work to Australian manufacturers, and interest had to be paid on the higher cost, electricity could not be supplied at a low rate. It is learned that owing to the high price of money, no new developments are proposed in this year's estimates in connection with the Tasmanian Government's big hydro-electric scheme. The New South Wales town of Lismore has adopted an electric lighting scheme involving an expenditure of £32,153. It will be municipally controlled. The Otira tunnel in New Zealand, which cost £800,000, is nearing completion. The electrification of the work will add another £382,000 to the expenditure.—*Reuter's Trade Service* (Melbourne).

Referring to his statement to members of the Nationalist Association that the Federal Government had decided to invite representatives of Australian employers and organised labour to meet and discuss the acute industrial crisis that had arisen from the high cost of production, Mr. Hughes recently stated that the present state of affairs was causing unemployment. The conference would consider Australia's impossible position which rested upon prices and wages created under war conditions that had now passed away. This matter was affecting the construction of the 12,000-ton Commonwealth ships for which Australian steel was preferred, but at prices comparable with those asked by foreign manufacturers.—*Reuter's Trade Service.*

LIGHTING AND POWER NOTES.

Aldershot.—Loan Sanctioned.—The Urban District Council has received sanction to a loan of £6,857 for electricity purposes.

Ashford (Kent).—Electricity Supply.—The Chamber of Commerce has petitioned the Urban Council to establish an electricity works in the town at the earliest possible moment.

Australia.—Victoria.—Recently the Attorney-General and the Chairman of the Electricity Commission of Victoria received a deputation from a number of local authorities who protested against the right obtained by the Electricity Commission to distribute electricity in their areas. The Attorney-General pointed out that the Government's aim was to supply electricity to the public at reasonable rates; the local councils regarded the matter in a commercial light and made large profits. The rights of the municipalities would be preserved so long as they did nothing to prejudice the purpose for which the Commission was created, but it would be impossible to follow municipal boundaries when the Morwell scheme was in full operation.

Ballymena.—Electricity Supply.—It is proposed to install electric lighting in the district at a cost of £5,500. A limited liability company is to be formed and a prospectus is in course of preparation.

Bideford (Devon).—Electricity Supply.—Messrs. Crompton & Co. have entered into an agreement for supplying electricity to Bideford, Northam, and Westward Ho! and a provisional agreement to supply Torrington. The estimated charges will be 10d. per unit for lighting and 3d. for power. It is proposed to use overhead mains.

Boston.—Order Sanctioned.—The Electricity Commissioners have sanctioned the Electric Lighting Order, 1915, which was held up on account of the war.

Ceylon.—Hydro-Electric Scheme.—The Lukapana-Aberdeen hydro-electric scheme, which offers vast possibilities of development, will be undertaken shortly.—*Reuter's Trade Service* (Bombay).

Continental.—France.—A new municipal 4,500-h.p. central station has just been completed in the town of Toulouse. The plant, which has been established with State assistance, utilises water power, the installation comprising six vertical-shaft alternators, three being driven by Escher-Wyss turbines and three by Gros-Pensonnet turbines. The electrical portion of the plant was supplied by the Compagnie Générale Electrique, of Nancy.

Finland.—The Hydrographical Department of the Finnish Government was engaged during the past summer in making an investigation of the general conditions and water-power possibilities of those parts of the Pasvig River which are situated within Finnish territory, the other parts being Norwegian. As a result of the examination, it is now stated that a minimum of 45,000 turbine h.p. could be rendered available for the use of the country. The works in connection with the projected utilisation of the Imatra Falls are to begin in the present year.

Germany.—The Unterweser Power Co., of Hamburg, has been formed in Berlin with a share capital of 30,000,000 marks to establish and carry on power stations, particularly a steam generating station, on the Lower Weser, near Farge. Siemens's interests are connected with the company.

Holland.—The Company for the Installation and Working of Low-pressure Networks, of Groningen, is offering a loan of 1,000,000 florins at 10½ per cent. The company, which was formed in 1913, has as exclusive shareholders the province of Groningen, and the local authorities in the concession area of the provincial electrical industry in Groningen and Drenthe. Its object is to install and work low-pressure networks and carry out electrical installations.

Spain.—A general strike was declared in Granada on February 11th, and the electricity and gas undertakings were carried on by detachments of troops.

Russia.—The President of the Government Planning Committee, M. Krzhizanovsky, stated recently that the electro-technical industry in the chief centres, Moscow, Petrograd, and Kharkoff, has been kept in good order and, with the aid of foreign capital, could be quickly developed. The first part of the electrification consists of the erection of 27 stations at a cost of two milliards of gold roubles. The second part of the programme embraces the installation of a further 75 central stations. Most of the heavy machinery and equipment will have to be imported. The means required for this development were only obtainable by co-operation with Western European capitalists, and the practical realisation of the plan required the organisation of a special bank for the purpose.

The Soviet Government has just concluded a contract with Swedish firms for the delivery of steam turbines to power stations to a total value of four million Swedish crowns. —*Morning Post.*

Dover.—Extension of Supply.—The Town Council has received a request from the Deal Town Council for a supply of electricity. The electrical engineer has been instructed to negotiate with the Deal engineer and to submit a report.

Fraserburgh.—Scheme Abandoned.—The Town Council has decided not to take any further steps in connection with the scheme for the supply of electricity, as it is considered that it would not be remunerative.

Glasgow.—Experimental Houses.—The Lord Provost last week formally opened two experimental houses which have been fitted up by the Corporation. In one house neither coal nor gas is being provided for, and electricity will be utilised for lighting, heating, washing clothes, washing dishes, and ironing. In the second house experiments are to be carried out with various kinds of smokeless fuel. The houses have been specially fitted up for the purposes of demonstration, and may be occupied for a year in order that the Corporation may acquire definite information as to the relative costs of electricity and gas.

India.—Punjab.—Correction.—In our issue of November 11th, 1921 (p. 642), we inadvertently stated that one of the standard high pressures adopted by the Punjab Government was 6,000 V; this should have been given as 6,600 V. In drawing our attention to this, Mr. F. L. Milne, electrical engineer to the Punjab Government, also mentions that the figure of 400 V between phases, at consumers' terminals, is meant to apply particularly to three-phase circuits giving a pressure of 230 V between phase and neutral. These pressures were considered by the committee which dealt with the question, to be preferable to the B.E.S.A. pressures of 380 and 220 V.

Jersey.—Electricity Supply.—On February 6th *The Evening Post* (St. Helier) published in full the report of Mr. Arthur Ellis, M.I.E.E., upon the possibilities of an electricity scheme for St. Helier. In summarising, Mr. Ellis considers that such a scheme is essential, and that municipal ownership would be more advisable than a private company. The undertaking should be successful and should become self-supporting within two years. A direct-current system is recommended, the supply being furnished by two (and ultimately three) 500-kW sets coupled to steam turbines. The initial expenditure is estimated at from £70,000 to £75,000, and the ultimate cost of the full scheme at from £100,000 to £120,000.

Littlehampton.—Electricity Agreement.—The Urban District Council has signed an agreement with the Sussex Electricity Co. for a supply of electricity to the town.

Liverpool.—Year's Working.—The annual report of the electricity department for the year ended December 31st, 1921, shows a total income of £995,988, as compared with £885,263 in the previous year. Working expenses amounted to £662,157 (£642,795), leaving a gross profit of £333,831, to which £10,000 has been added, being the amount withdrawn from the Fuel Guarantee Fund. This has been distributed as follows:—Interest, £110,335; sinking fund, £86,550; renewal fund, £86,946; and contribution to consolidated rate, £60,000.

London.—Stepney.—The Borough Electrical Engineer has submited a report to the Council outlining a number of electricity extensions which have become necessary. He recommends the expenditure of £300,000, made up as follows:—Sub-station plant and switchgear, £27,640; e.h.p. cables and switchgear, £94,543; l.p. feeders and switchgear, £59,150; l.p. distributors and street boxes, £45,000; service lines, £20,000; meters, £7,000; buildings, &c., £6,000; machinery (sundry items), £13,505; and contingencies, £27,162. The Finance Committee recommends application to borrow the sum required. The Council is also recommended to borrow the sum of £31,650 to cover excess expenditure upon machinery.

Luton.—Electricity in Bulk.—The North Metropolitan Electric Power Supply Co. has asked the Town Council for a supply of electricity in bulk for a period of 21 years from October 1st next. The company offers to pay a fixed charge of 15s. per kW of maximum demand per quarter, and a charge per unit equal to the actual cost of fuel used per unit generated throughout the quarter, plus 25 per cent. The capital outlay for additional plant needed to provide the supply will be £12,000.

Maidenhead.—New Plant.—The Town Council is applying to the Electricity Commissioners for sanction to install at the electricity works a 200-kW semi-Diesel engine.

Malaya.—Kedah.—Alor Star, the capital of Kedah (under the suzerainty of Great Britain), has been provided with an electricity supply. The plant, which is all-British, consists of Tangye semi-Diesel engines driving 60-kW d.c. E.C.C. generators. These run at 600 r.p.m. and generate current at 230 V. The streets are well lighted; fittings of a special design were supplied by the Wardle Engineering Co., Ltd. The general price of energy to private consumers is 30 cents (8½d.) per unit. Messrs. Huttenbach, Lazarus & Sons, Ltd., obtained and erected the installation, and they operate the plant under licence from the Kedah Government.

Malvern.—Price Reduction.—The Urban Council has decided that, pending a complete revision of the charges for the supply of electricity, consumers of 5,000 units or over per annum for lighting purposes shall be supplied at 1d. less than the price charged to ordinary consumers, and that in such cases no discount shall be allowed.

Monmouth.—Supply in Bulk.—The Corporation has entered into an agreement with the Hereford City Council for a supply of electricity in bulk.

Nantyglo.—Electricity Supply.—The Ebbw Vale Co. has offered to supply electricity to the town at a flat rate of 2½d. per unit. If the offer is accepted the charge to the public will be 8d. per unit.

Navan.—New Power Station.—The Urban District Council is to erect a power station at a cost of £9,970. The charges to consumers will be 9d. per unit for lighting and 3d. for power. A loan of £12,000 is being applied for.

Rickmansworth and Chorley Wood.—Extension of Time. —The Minister of Transport has extended the time until August, 1922, of the Rickmansworth and Chorley Wood Electric Lighting Order, 1914, for the extension of mains, &c.

Truro.—Electricity Supply.—The Town Council has decided to submit to the Electricity Commissioners an electric light scheme prepared by Dr. Purves, and an amended offer to supply electricity in bulk made by the Cornwall Electric Power Co. Steps are to be taken to ascertain the probable number of consumers in the town.

Worcester.—Purchase of Plant.—The City Council has decided to purchase generating plant lying at Southampton at a cost of £24,000, and to extend the electricity undertaking at a cost of a further £38,000.

Ystradgynlais.—Electricity Scheme.—The Rural District Council has applied to the Electricity Commissioners for a special order authorising the purchase of the Glantawe Electric Supply Co.'s undertaking and the supply of electricity for public and private purposes.

TRAMWAY AND RAILWAY NOTES.

Bradford.—Loans.—A public inquiry was recently held at the Town Hall by the Ministry of Transport into an application by the Corporation for borrowing powers, in connection with a Provisional Order amending various local Acts of Parliament, and giving it power to undertake certain public works involving an estimated total expenditure of over 2¼ millions sterling. The scheme involves the expenditure of £300,000 for the reconstruction and renewal of tramway tracks; £150,000 for extensions to the depôt and erection of tramway sheds; and authorises the Corporation to use railless trolley vehicles on routes in and around the city. It was pointed out that unless powers for trolley vehicles were obtained it might become necessary, owing to the greatly increased cost of relaying tramway track, to shut down the tramway service altogether. The scheme was opposed by local industrial bodies, who contended that in view of the straitened financial condition of the city, the proposed work should be suspended for at least five years.

Application is being made to the Minister of Transport for sanction to borrow £15,994 for renewal of the tramway track from Tyrrell Street to Listerhills Road.

Canada.—Railway Electrification.—The vice-chairman of the London & Port Stanley Railway System, Mr. Phillip Pocock, stated recently that he had been informed that the Michigan Central Railway Co. was considering the electrification of its Canadian line between Niagara Falls and Windsor. He considered that the starting-up of the new power plant at Chippawa would have a considerable bearing on this project —*Electrical News.*

Continental.—Switzerland.—The electrified St. Gothard Railway will shortly be opened on the whole line between Göschenen and Chiasso.—*The Times.*

Finland.—The question of the electrification of some of the Finnish State railways is engaging the attention of a committee appointed by the general directors of the railways. This committee is said to be occupied at present in conjunction with "a German expert" in working out a definite scheme of railway electrification.

L.B. & S.C. Railway.—Electrification Postponed.—The London, Brighton & South Coast Railway Co. has decided to postpone, for the time being, at any rate, the big scheme for the further electrification of its main line to the South Coast. The decision has been necessitated owing to lack of the financial resources essential for the carrying out of the work. A full statement of the position was to have been made by the chairman at the annual meeting of shareholders on Wednesday last.

It is suggested in well-informed quarters that the abandonment is only of a temporary nature. The prime cause of the postponement is, of course, the decision, as announced in the annual report, not to proceed with the Bill now before Parliament asking for powers to borrow £1,000,000. Arrangements are now being made in other directions with a view to settling the financial question, and there is very little doubt that the further electrification scheme will be proceeded with in the not distant future.—*Financial Times.*

At the meeting referred to above, the Chairman stated that the principal bar to proceeding was the inability of the Southern railway companies to agree upon the system of electrification. A Ministry of Transport Committee was considering the matter.

Liverpool.—Year's Working.—The report of the tramways undertaking for the year ended December 31st, 1921, shows a deficit of £48,576.

London.—Danger to Tramcar Passengers.—In order to guard the public from the danger attendant upon the practice of fast-moving vehicles passing between the pathway and stationary cars, the L.C.C. recently requested the Minister of Transport to make a by-law compelling vehicles to reduce their speed on these occasions. The Minister has replied regretting his inability to do this, and also stating that he cannot see his way clear to introduce special legislation for the purpose.

Rochdale.—Accident.—On the night of February 9th a Corporation tramcar descending a steep gradient in John Street suddenly got out of control and rushed to the bottom of the hill—a distance of about 400 yards. Here it left the track, mounted the pavement, and crashed into a shop window. The car then overturned and 17 passengers were injured, eight of them seriously. This is the second accident of its kind at this place, the last occurring in 1914.

Sunderland.—Strike.—The employés of the Sunderland District Tramways, Ltd., ceased work on February 2nd as a protest against wages reductions. Under the National Agreement the men were liable to a reduction, but the company proposed to make further reductions up to a maximum of 10s. per week in the case of the highest-paid men, its reason being that in consequence of depression in the coal industry, the revenue was so diminished that the company could not afford to continue the present wages bill. The company had accordingly broken away from the Industrial Council.

TELEGRAPH AND TELEPHONE NOTES.

Italy.—Telegraphic Communication.—Both ordinary and wireless telegraphic communication were to be resumed between Italy and Russia on February 15th, says the *Daily Express.*

Continuing its preparations for the Genoa Conference, the Italian Government, on February 10th, tested a direct telephone line between Brussels and Genoa. Despite the distance, says the *Daily Telegraph*, the conversations were quite clear.

Russia.—Telegraph Communication.—The Great Northern Telegraph Co. is restoring its Copenhagen-Petrograd-Peking line. Owing to cable defects between Petrograd and Copenhagen, communication has been provisionally established by way of Finland and Sweden. The Petrograd-Peking line has been restored as far as Irkutsk.—*Reuter's Trade Service* (Reval).

Spain.—Government Takes Over Telephone System.—Reversions to the Government of telephone franchises began on December 9th, 1921, when the lines in the city of Barcelona were officially taken over and nearly all the remaining lines of the country will have become Government property within the next five years. Concessions to operate telephone systems in Spain were granted for periods averaging 40 years, and all contained a reversion clause whereby the Government has the right to take over the lines without remuneration at the expiration of the franchise.—*T. & T. Age.*

United States.—Wave Lengths and Broadcasting.—The wireless wave lengths assigned by the American Government to the different classes of stations roughly are as follows:—Trans-Atlantic, from 12,000 to 16,000; limited commercial service, from 2,600 to 2,700; Post Office, from 3,000 to 4,200; Navy, from 600 to 1,600; commercial, from 300 to 600; special amateur, from 275 to 350; and general or restricted amateur, 200 metres. Wireless inspectors have recently been authorised by the Department of Commerce to insert in all general and restricted amateur station licences the following:—"This station is not licensed to broadcast weather reports, market reports, music, concerts, speeches, news, or similar information or entertainment.—*T. & T. Age.*

Wireless Telegraphy.—New Printer.—Engineer Shorin, of the Nijni-Novgorod wireless laboratory, has successfully demonstrated his automatic radio-telegraphic apparatus for receiving dispatches and printing them automatically with remarkable rapidity, according to a Soviet official message.

Wireless Telephony.—The first of a series of regular wireless telephone transmissions for the benefit of English wireless amateurs took place on the evening of February 14th. The Marconi Scientific Instrument Co., one of the associated Marconi companies, prepared a 15-minute musical programme for the occasion; instrumental selections were transmitted through the medium of the "Cliftophone." The first telephonic item was radiated at 7.35 p.m. (Greenwich) on a wave length of 700 metres. This was preceded by a series of telegraphic signals for calibration purposes, starting at 7 p.m. on 1,000 metres. The Marconi station at Writtle, Essex, conducting these transmissions, has the call letters 2 MT. The power employed for telephony was limited to 250 watts, in accordance with the terms of the Post Office licence.

Proposed London-Denmark Service.—According to the *Copenhagen*, a representative of the Marconi Co. from London has been to Copenhagen to discuss the establishment of a wireless telephone service between the two cities with the Danish authorities concerned. It was arranged that a series of experiments should be carried out in the course of the spring in order to ascertain whether such communication is possible. Similar experiments with good results have taken place between London and Amsterdam. An experiment in conversation by wireless telephone between Zandvoort, in Holland, and Southwold, Suffolk, was made last year.—*The Times.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Ashton-under-Lyme.—February 22nd. Electricity Committee. Circulating water pipes and valves and exhaust steam pipes. (February 3rd.)

Australia.—Melbourne.—April 29th. Victorian Electricity Commissioners. 31 miles .15 sq. in. 3-core power cable and 20 miles .007 pilot cable, with accessories, for a 22,000-V circuit. —*Reuter's Trade Service* (Melbourne).

April 5th. Commonwealth P.M.G. Telegraph condensers. (Sched. 613.)

April 19th. Telegraph and testing instruments. (Sched. 549.) (February 10th.)

Adelaide.—April 5th. P.M.G.'s Department. Twelve adjustable condensers for use on telegraph duplex circuits. (Sched. No. 613.)*

Brisbane.—April 19th. P.M.G.'s Department. Testing and telegraph instruments. (Stores Sched. No. 549.)*

Aylesbury.—Electricity Department. One 1,500-kW or alternatively one 1,000-kW turbo-alternator, condenser, and switchgear. (February 3rd.)

Belfast.—February 28th. Tramways Committee. Six or 12 months' supply of tramway stores, including electrical accessories, cable, lamps, &c. (February 10th.)

Burton-on-Trent.—February 22nd. Electricity Department. One 6,000-kW turbo-alternator with condenser and switchgear. Two 40,000-lb. water-tube boilers complete with economisers, coal-handling plant, bunkers, buildings, and chimneys. (February 3rd.)

Dundee.—February 27th. Electricity Department. Five sets of converting machinery. Mr. H. Richardson, general manager and engineer.

Edinburgh.—March 20th. Electricity Department. Auxiliary plant and pipework (Spec. No. 41). (See this issue.)

East Grinstead.—February 24th. U.D.C. Two-stroke oil engine-driven generators and other plant and electrical equipment. (February 3rd.)

India.—Calcutta.—March 20th. Municipal Council. Eight electric lorries and motor-generator charging sets. Particulars from chief engineer to the Corporation.—*Reuter's Trade Service* (Calcutta).

Leeds.—February 27th. Tramways and Highways Committee. Twelve months' supply of electrical sundries. Mr. J. B. Hamilton, general and commercial manager, 1, Swinegate, Leeds.

London.—Hammersmith.—February 22nd. Electricity Department. Stores for three, six, or twelve months. (February 3rd.)

Paddington.—February 20th. G.W.R. Three months' supply of electrical and telegraph stores. (February 3rd.)

Metropolitan Asylums Board.—March 1st. Installation of electric lighting and power, telephones and fire alarms; and continuous drying machine, for the Eastern Fever Extension Hospital, Homerton. (See this issue.)

Manchester.—February 21st. Electricity Committee. C.I. water tanks and accessories. (Spec. B27.) February 27th. L.p. valves, cocks, &c. (Spec. B28.) L.p. pipework for auxiliary services (B29).

Portsmouth.—Electricity Department. Economisers, steam pumps and circulating pumps. (See this issue.)

South Africa.—Durban.—April 12th. Corporation Electricity Department. Two 500-kW rotary converter sub-station equipments or alternatively mercury arc rectifiers with automatic switchgear.*

Skipton. — February 25th. Electricity Department. Supply, laying and jointing l.p. 4-core paper-insulated lead-covered steel-tape armoured cable. (February 3rd.)

Wigan.—March 13th. Electricity Department. Steam turbine, 5,000 kW, 3-ph. alternator and exciter, and surface condensing plant. (See this issue.)

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Bolton.—The tender of the English Electric Co. for the supply of a rotary converter for Spa Road electricity works has been provisionally accepted by the Corporation.

Tramways Committee. Accepted :—

Rail-grinding and welding plant for use on the tramway track.—Equipment & Engineering Co., London.

London.—Stepney.—Electricity Supply Committee.

One mile "B" troughs and covers, £234; 1 mile 3-in. earthenware pipes, £306.—Sutton & Co. (Accepted.)

Feeder panel at Wapping sub-station in connection with the bulk supply of electricity to the London Hydraulic Power Co. for the motor-driven pumps at Wapping, £384.—A. Reyrolle & Co., Ltd. (Recommended.)

South Africa.—Messrs. Ruston & Hornsby, Ltd., have secured a contract from the Government of South Africa for 38 heavy oil engines to be supplied to the South African Railways and Harbours Department for driving grain elevators and for electric lighting purposes in different parts of the country. The order, which is understood to be for approximately 2,500 b.h.p., was secured after very severe competition.

Worthing.—Electricity Committee. Further to our note on p. 200 in our last issue, the following tenders were received for the 500-b.h.p. Diesel engine and generator :—

	£
Hick, Hargreaves & Co., Ltd.	13,687
English Electric Co., Ltd.	12,105
Mirrlees, Bickerton & Day, Ltd.	12,314
Sulzer Bros.	11,715
Krupp, A. G.	7,810

The electrical engineer reported that Messrs. Mirrlees, Bickerton & Day's tender included £1,584 for a Crompton and Co.'s dynamo, and as their engine would be a duplicate of the last purchased, additional spares would be unnecessary, and would reduce this firm's quotation to £11,739. The committee recommended the acceptance of Messrs. Mirrlees's tender.

At the Town Council meeting, the Deputy Mayor (Alderman Whyte), the chairman of the Finance Committee, objected to the spending of nearly £4,000 more than would be necessary if they accepted the offer of the German firm. The Council, by 20 votes to 3, decided to accept the British tender.

For the supply of cables, 10 tenders were received :—

	£
Enfield Ediswan Cable Works (Accepted)	1,591
Hackbridge Cable Co., Ltd.	1,658
Pirelli General Cable Works, Ltd.	1,782
Callender's Cable and Construction Co., Ltd.	1,965
Siemens Bros. & Co., Ltd.	1,993
Johnson & Phillips, Ltd.	1,995
W. T. Glover & Co., Ltd.	2,017
Western Electric Co., Ltd.	2,020
W. T. Henley's Telegraph Works Co., Ltd.	2,031
Union Cable Co., Ltd.	2,043

FORTHCOMING EVENTS.

Royal Society of Arts.—Monday, February 20th. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture, "The Mechanical Design of Scientific Instruments," by Prof. A. F. C. Pollard.

East India Association.—Monday, February 20th. At the Caxton Hall, Westminster, S.W. At 3.30 p.m. Paper on "Hydro-electric Power in India," by Mr. A. T. Arnall.

Institution of Electrical Engineers.—Commemoration meetings—Tuesday, February 21st. At the Institution, Victoria Embankment, W.C. At 3 p.m. Experimental lecture by Prof. J. A. Fleming, F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

Wednesday, February 22nd. 3.30 to 6 p.m. Short discourses on "Reminiscences and Experiences of Electrical Engineering in both its Technical and Legislative Aspects." At 8.30 p.m. Prof. Fleming will repeat his lecture of the previous day.

Thursday, February 23rd. 2.30 to 6 p.m. and 8 to 10 p.m. Continuation of discourses on "Electrical Engineering."

Tuesday, February 21st. At the Hotel Cecil. At 7 for 7.30 p.m. Annual dinner.

Informal Meeting.—Monday, February 20th. At the Institution. At 7 p.m. Discussion on "The Emergency Use of Oil Fuel during the Recent Coal Strike," to be opened by Mr. E. F. Hetherington.

(South-Midland Centre).—Wednesday, February 22nd. At the University, Birmingham. At 7 p.m. Paper on "Rotary Converters," by Mr. F. P. Whitaker.

(North-Western Centre).—Tuesday, February 21st. At the Engineers' Club, Manchester. At 7 p.m. Discussion on "The Utilisation of Waste Heat from Electrical Generating Stations," with introductory papers by Messrs. C. I. Haden and F. H. Whysall.

(Liverpool Sub-Centre).—Monday, February 20th. At the University, Liverpool. At 7 p.m. Lecture on "An Oscillograph Investigation of the Gulstad Relay," by Dr. S. S. Richardson.

Institution of Civil Engineers.—Tuesday, February 21st. At the Institution, Great George Street, S.W. At 6 p.m. Discussion on Mr. Parshall's paper on "Hydro-Electric Installations of the Barcelona Traction, Light and Power Co.," and paper on "The Improvement of the Port of Valparaiso." by Mr. A. C. Walsh and Mr. W. F. Stanton.

Institute of Cost and Works Accountants.—Wednesday, February 22nd. At the Institute of Patent Agents. At 7 p.m. Lecture on "Some Units of Measurement," by Mr. J. C. Todman.

Industrial League and Council.—Wednesday, February 22nd. At Caxton Hall, Westminster, S.W. At 7.30 p.m. Lecture on "A Proposed Solution to the Transport Problem," by Mr. R. Horniman.

Paisley Association of Electrical Engineers.—Wednesday, February 22nd. At the Y.M.C.A. Buildings, 25, High Street. At 7.30 p.m. Paper on "Switchgear," by Mr. D. Martin.

Northampton Engineering College Engineering Society.—Wednesday, February 22nd. At Northampton Institute, St. John Street, E.C. At 5.30 p.m. Paper on "Commercial Testing of d.c. Motors and Generators," by Mr. A. T. Davis.

British Electrical Development Association.—Wednesday, February 22nd. At the Hotel Cecil, Strand, W.C. At 12 noon. Second annual general meeting. 1 o'clock for 1.15 p.m. Luncheon.

Chelmsford Engineering Society.—Thursday, February 23rd. At the East Anglian Institute of Agriculture. At 7 p.m. Ordinary meeting.

London Electrical Engineers, 24/26 L.A.S.S. Co.—Thursday, February 23rd. At the Bridge House Hotel, London Bridge, S.E. Annual dinner.

Edinburgh Electrical Society.—Friday, February 24th. At the Philosophical Institute. At 8 p.m. Paper on "Some Experiments in Electrical Sound Detecting," by Mr. B. A. Pilkington.

Junior Institution of Engineers.—Friday, February 24th. At Caxton Hall, S.W. At 8 p.m. Lecture, "Curved Beams, Rings, and Chain Links," by Prof. E. G. Coker.

Institution of Production Engineers.—Friday, February 24th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 7.30 p.m. Paper on "Intensive Production of Automobile Bodies," by Mr. G. W. Eastwood.

Birmingham and District Electric Club.—Friday, February 24th. At the Grand Hotel, Colmore Row. At 7 p.m. Annual dinner.

Electrical Power Engineers' Association.—Friday, February 24th. At the Engineers' Club, Coventry Street, W. At 7 p.m. Informal discussion on "Boiler Troubles."

Physical Society of London.—Friday, February 24th. At the Imperial College of Science, South Kensington. At 5 p.m. Ordinary meeting.

Technical Inspection Association.—Friday, February 24th. At the Royal Society of Arts, John Street, Adelphi. At 7.30 p.m. Lecture on "The Extrusion of Metals," by Mr. R. Genders.

Manchester Wireless Society.—Saturday, February 25th. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Smoking concert.

THE JUBILEE OF THE INSTITUTION OF ELECTRICAL ENGINEERS.—I.

The Society of Telegraph Engineers was founded in 1871, mainly owing to the efforts of Major F. Bolton and Captain C. E. Webber, R.E. (who afterwards respectively became Sir Francis Bolton and Major-General Webber). The opening meeting was held on February 28th, 1872, when Mr. C. W. Siemens (afterwards Sir William Siemens) took the chair as the first President—the first of a long series of men distinguished in science, engineering, and industry, whose names with few exceptions are of world-wide reputation, and form a crown of glory to the society for which they laboured. The original list of members, which we print elsewhere, contained 71 names (Sir William Thomson joined the Society a few days later); at the end of the first year it had swollen to 110 names. The hon. treasurer was Robert Sabine, and the hon. secretary Major Bolton; the auditors were Messrs. J. W. Blundell and F. C. Danvers. Many names well known in the electrical industry will be found in the list: Latimer Clark, Carey Foster, Fitzgerald, Graves, Henley, Langdon, Preece, Phillips, Willoughby Smith, Spagnoletti, Siemens, Sabine, the Varleys, Webber, Whitehouse, Canning, Culley—these will awaken memories in the hearts of many of our readers.

Sir William Siemens, D.C.L., F.R.S.,
President of the Society of Telegraph Engineers, 1872 and 1878.

Of the original founders, two alone survive—Col. Sir Herbert Jekyll, K.C.M.G., and Col. Edward Donald Malcolm, C.B., R.E. Of the former we are glad to reproduce a photograph; the latter, unfortunately, is on the Continent, and we are unable to obtain a portrait of him. We give portraits also of Sir William Siemens, one of the founders of the British company, and of Mr. George E. Preece, who was in effect the first secretary, though Mr. H. S. Wilson held that post for a few months.

Sir Herbert Jekyll, who was born in 1846, served with distinction 35 years in the Royal Engineers, and occupied many posts in the Civil Service, the last being that of Assistant Secretary to the Board of Trade (1901-1911), in which capacity he was well known to the electrical industry. Col. Malcolm was born in 1837, and served 40 years in the Royal Engineers, taking part in the Crimean War and the Indian Mutiny, and gaining several honours; he also served the public in various capacities. Incidentally, Capt. Malcolm read a paper before the Society on April 26th, 1872.

In the early days the Society was naturally concorned mainly with telegraphic questions, but from the commencement it was foreseen that a broader field would open before it; at the opening meeting Mr. C. F. Varley said: "This Society, I assume, will gradually, by natural selection, develop more into an electrical society than into a society of telegraphy proper; and the moment it is understood that all papers on electricity or bearing directly upon the development of electrical

George E. Preece,
Secretary to the Society, 1872.

Photo by [*Elliott & Fry.*

Col. Sir Herbert Jekyll, K.C.M.G.,
One of the Surviving Founders of the Society.

science are admitted, it at once takes the science out of the narrow groove into which it seemed to be drifting, into the most extensive of all grooves, because it will be found ultimately to embrace every operation in nature." Varley was a true prophet; who can set bounds to the scope of electricity? Every advance in our knowledge of the structure of the universe—and enormous strides have been made since his day—increases the probability

Sir William Thomson (Lord Kelvin) in 1870.
Reproduced by permission of Messrs. Macmillan & Co., Ltd., from the "Life of Lord Kelvin."

that electricity "embraces every operation in nature." As Varley foresaw, the specialist character of the original body was soon merged in a diversity of electrical interests; by 1880 the membership had increased to 980, and in the following year the Society became the Society of Telegraph Engineers and Electricians. In 1883 the present title was adopted. The membership continued to increase without a check, as the following

Photo by [*Elliott & Fry.*
Sir William Crookes, F.R.S.

figures will show:—1890, 1,760; 1900, 3,660; 1910, 6,210; 1920, 8,437—and a few weeks ago it triumphantly passed the 10,000 mark, almost 100 times the total at the end of its first year of existence.

A perusal of the list of past-presidents of the Institution reminds us of the splendid pioneer work accomplished by British electrical engineers, members of the Institution; amid so brilliant an assembly it seems invidious to make distinctions, but the limitations of our space compel it, and we have selected for portraiture that colossal figure, Lord Kelvin, who with Sir William Siemens may be taken to represent the telegraphic interests on which the Society was founded; Dr. John Hopkinson, who established the theory of the dynamo

Sir Joseph W. Swan, F.R.S.

on a firm basis; Sir Joseph W. Swan, the inventor of the incandescent lamp; and Sir William Crookes, whose researches paved the way to the electron theory, the thermionic valve, and the X-rays.

The first meetings of the Society of Telegraph Engineers were held at the Institution of Civil Engineers; but the Electrical Engineers long aspired to possessing a home of their own, and in 1909 they acquired the

Photo by [*Elliott & Fry.*
Dr. John Hopkinson, F.R.S.

handsome building on the Embankment, in which next week the Institution will fittingly celebrate the attainment of its jubilee by first of all paying homage to the memory of the immortal Faraday, the father of electrical engineering, after which a number of eminent members will deliver short discourses.

THE MERSEY POWER CO., LTD.

THE NEW RUNCORN POWER STATION.

Some eleven years ago the Salt Union, Ltd., established a triple-effect vacuum plant at Weston Point, Runcorn, near Liverpool, for the economical production of salt by evaporating brine—incidentally, the brine used is conveyed to Runcorn from Northwich in the Mid-Cheshire salt district by means of a pipe line—for which process a large amount of low-pressure steam was needed. When erecting the generating station to furnish the necessary steam, Mr. G. W. Malcolm, engineer and managing director of the Salt Union, incorporated turbo-generators in the plant, so that the steam is made to do useful work in producing electricity before it is exhausted into the salt-making plant.

Of the electricity so produced a portion is utilised in the salt works themselves, but the bulk is available for other purposes; the Salt Union therefore sought Parliamentary powers to facilitate the disposal of its surplus electricity, and it was authorised to give a public supply. To deal with the latter business a subsidiary company—the Mersey Power Co., Ltd.—was formed in 1911, to which the Salt Union's Provisional Orders were transferred, and met with success from the start; it laid transmission and distribution mains, purchasing electricity from its parent company at the generating station bus-bars. The public supply commenced in January, 1912, during which year 1½ million kWh were sold; in 1920 that figure had grown to 25 millions. Additional plant was installed from time to time until ultimately a generating capacity of 8,250 kW was available to meet the public needs. Nevertheless the 1918 demand for electricity made it evident that the surplus energy from the salt-making industry was inadequate to meet the public demand for electricity, and the Mersey Power Co., Ltd., was forced to build a new steam generating station to furnish the excess energy that was called for.

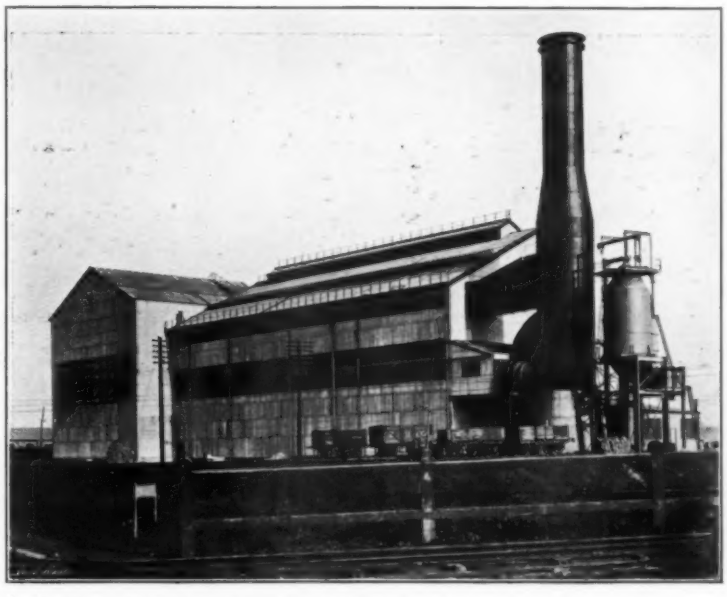

Fig. 1.—Exterior of Runcorn Power Station.

The area within which the company is authorised to supply electricity includes the urban and rural districts of Runcorn and the borough of Widnes, but the company is also permitted by Fringe Orders to furnish considerable quantities of energy to individual consumers at Ellesmere Port and elsewhere, and it is at present seeking power to extend the area so as to include Ellesmere Port. The area in question is within the Mersey and West Lancashire Electricity District, and it will be remembered that the result of the Electricity Commissioners' inquiry in connection with that district* was to give the Mersey Power Co., Ltd., complete autonomy within its area of supply and power to extend its operations, subject, of course, to the control of the Electricity Commission.

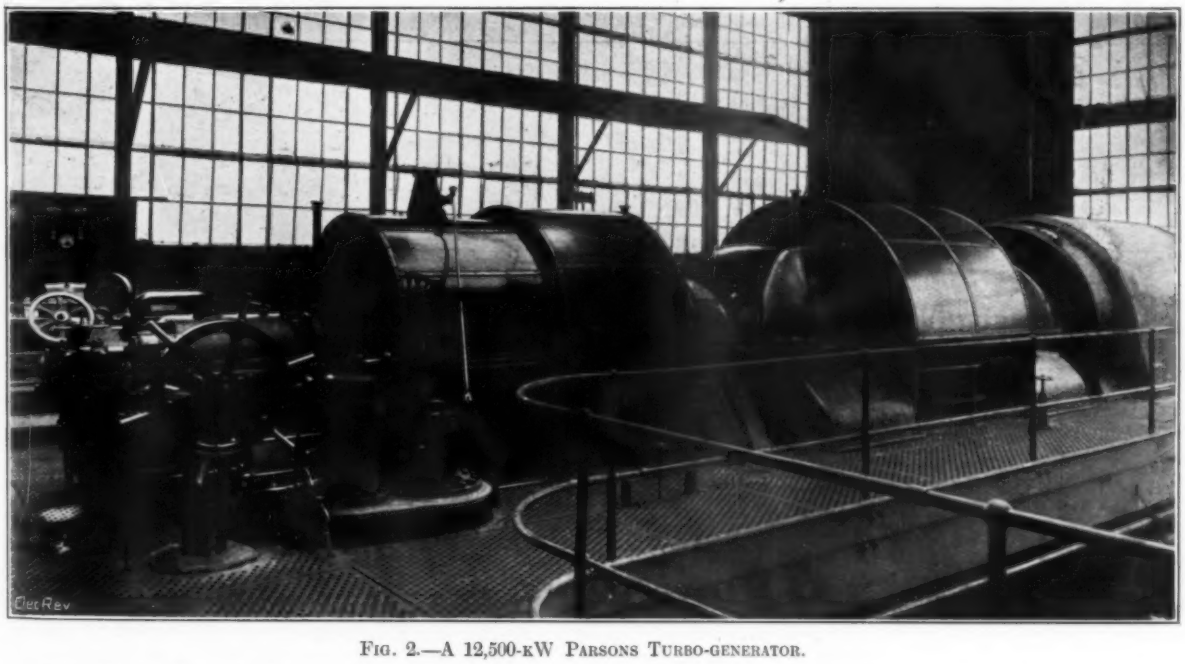

Fig. 2.—A 12,500-kW Parsons Turbo-generator.

*Elec. Rev., February 11th and April 22nd, 1921.

The company operates 27 sub-stations, and the system of supply is an a.c., 3-phase, 50-cycle one at a pressure of 440 volts for power purposes, while lighting is done on the single-phase system at 250 volts; energy is transmitted over long distances at a pressure of 33,000 volts and over short distances at 6,000 and 3,000 volts.

Fortune favoured the selection of the 27-acre site of the new generating station; it is adjacent to the old station, water to an almost unlimited quantity is obtainable for condensing purposes, and facilities exist for the delivery of either rail- or water-borne fuel. The new station has been designed by the company's consulting engineers—Messrs. Merz & McLellan—to be readily extendable to an ultimate capacity of 100,000 kW, and it is expected that when it is in full running order the steam consumption will be under 10.15 lb. per kWh generated; at the moment two 12,500-kW turbo-alternators produce 50-cycle energy at a pressure of 6,450 volts. With a good load factor the station, which was officially inaugurated on November 25th, 1920, commenced its career with bright prospects of success.

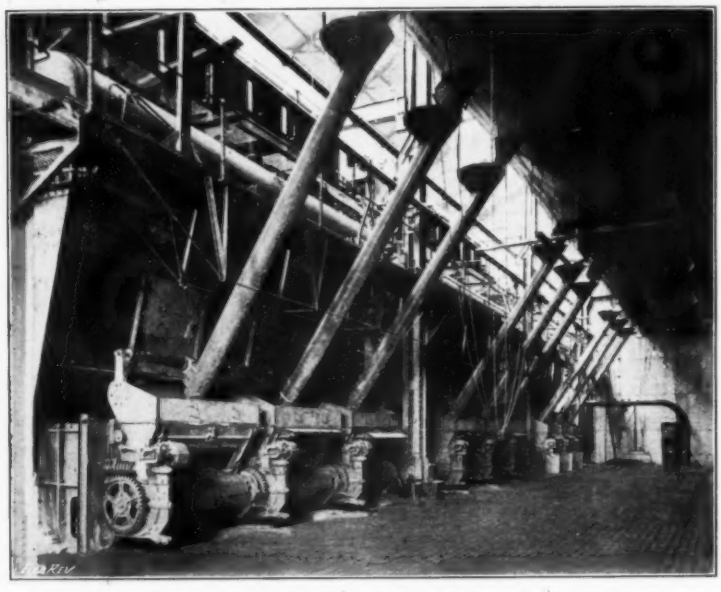

Fig. 3.—Boiler House.

The excavating work and foundation laying for the new buildings was undertaken by Messrs. Walter Jones and Sons, Ltd., of London, who, while building the foundations, installed the whole of the necessary pipes and ducts in and around the station so as to enable the cables to be drawn in afterwards. The building is a steel-framed structure clothed with corrugated asbestos sheets. The whole structure is so arranged that an additional bay can be easily added to both the boiler-house and engine room; the total weight of the steel used in constructing the boiler-house alone was approximately 770 tons, and a feature of the station is its extreme compactness. The building itself was constructed by Messrs. Heenan & Froude, Ltd., of Manchester, and an exterior view of it is seen in fig. 1.

The railway sidings consist of about two miles of track, fed from the Manchester Ship Canal Co.'s docks, and were constructed by Messrs. W. Jones & Sons, Ltd.; there is still under construction a siding that will communicate with the London & North-Western Railway. The railway track passes over two underground steel-plate hoppers into which the coal is tipped; beneath the hoppers jigging grids are installed that allow all lump coal to pass over them into a crusher which is situated below. The latter machine discharges the crushed coal on to a conveyor that elevates it to the bunkers located along the top of the boiler-house; the conveyor is of the endless chain and gravity bucket type, and is capable of holding 800 tons of fuel. The coal is supplied to each boiler through three cast-iron mouthpieces that contain special regulating valves. The side plating of the bunker is extended for some 10 ft. above the sides of the bunker in corrugated iron to the roof in order to form a dust screen.

The coal-handling plant, boilers, flues, pipe work, and chimney were supplied by Messrs. Babcock & Wilcox, Ltd., of London, who installed three water-tube boilers (fig. 3), each of which is capable of evaporating continuously 45,000 lb. of water to steam at a pressure of 270 lb. per sq. in. and superheated to between 675 and 700 deg. F. Each economiser is built up of a group of solid-drawn steel tubes heavily galvanised both inside and out, and fitted into steel headers.

Fig. 4.—Outdoor 6,500/33,000-volt Transformer Sub-station.

(To be concluded.)

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to inquiries received this week, we need the names of suppliers or manufacturers of :—

H. & H. insulating tapes.

Electrically-operated steam valves of small diameter (inch to inch and a-half), which could be controlled by means of a thermostat.

Raw-hide slings, for supporting electric cables.

Insulating adhesive glue, applicable in similar way to carpenter's glue.

NOTES.

The Society of Telegraph Engineers.—The following is a list of the original members of the Society of Telegraph Engineers, referred to on p. 233 :—

F. Bolton	C. William Siemens
Fred. Beaumont	Carl Siemens
C. Becker	*Frank Ives Scudamore
†Philip Howard Colomb	Robert Sabine
John T. Burt	†Richard H. Stotherd
Richard Collett	R. J. Scott
Sackville A. Cecil	Herbert Taylor
†Latimer Clark	A. L. Ternant
†George Carey Foster	Frederick Henry Varley
Desmond G. Fitzgerald	S. Alfred Varley
John Henry Greener	Octavius Varley
A. Graves	†C. F. Varley
George S. Grimston	T. P. B. Warren
Nathaniel John Holmes	†C. E. Webber
W. T. Henley	†E. O. W. Whitehouse
Thomas Evans Lundy	Knapp Barrow
Wm. Langdon	Alfred Eggington
L. Loeffler	Thomas Fletcher
Henry Moxon	Richard Higgs
Samuel J. Mackie	E. Graves
†E. D. Malcolm	†G. G. Newman
Emil Naglo	M. Theiler
W. H. Preece	Fred. C. G. Ritso
Geo. E. Preece	Geo. Henley
S. E. Phillips, Junr.	Langham Rokeby
Sam. E. Phillips	Frederick Fraisi
Theophilus Smith	Frank R. Francis
James Radcliffe	H. Jekyll, R.E.
†Willoughby Smith	James McLean
W. H. Shaw	John Bourdeaux
C. E. Spagnoletti	*Lord Lindsay
Henry Sach	†S. Canning
E. O. Brown	†R. S. Culley.

*Vice-President.
†Member of Council.

Finsbury Technical College Old Students' Association.—On January 27th Old Students of the Finsbury Technical College met at an informal dinner and smoking concert at the Engineers' Club, Coventry Street, London, W. Mr. W. G. Head, M.I.Mech.E., president of the Association, presided, and was supported by a number of past presidents and vice-presidents. Among the guests were Dr. Armstrong, F.R.S., Mr. A. C. Chapman, F.I.C., F.R.S., president of the Institute of Chemistry, Mr. R. B. Pilcher, Professor A. J. Hale, F.I.C., and Mr. J. K. Catterson-Smith, M.I.E.E. Under the direction of Mr. L. M. Clark a pleasing and well-varied programme was supplied by Messrs. Raymond Iles, G. M. Jeffrays, G. Thomas, Ivor Jones, and Ralph Frazer, with Mr. L. Regan, F.R.C.O., at the piano. Additional items were given by Messrs. Pilcher, R. O. Grant, and W. J. Tennant.

Fatality.—A coal-cutting machine man, named Wm. Cairns Paterson, was killed at Rosehall Colliery, Coatbridge, recently. He had been at work on the machine and put his hand on one of the switches receiving a severe shock.

A French "Leader" Cable.—For the last six months the Havre Chamber of Commerce has been studying with M. Loth the possibility of establishing an electric "Leader" cable running out from the port to the lightship moored westward of Cap de la Heve and probably beyond the lightship in a direction parallel with the coast up to Cap d'Antifer. This would make the cable some thirty miles in length. It would be laid in the navigable channel and carry an alternating current which would act by induction on a small apparatus carried on board the ship, and the sounds would indicate whether the vessel was following the course of the cable or not. The chief use of the cable would, of course, be to guide ships in foggy weather and, although fogs are rare at Havre, the authorities consider that the cable would prove a considerable time-saver to navigators. The Havre Chamber of Commerce will shortly hold a special plenary session at which the adoption of the scheme will probably be decided upon.—*Reuter's Trade Service (Paris).*

Australian Wireless Telegraphists.—In connection with the claims of the Radio Telegraphists' Institute of Australasia relating to rates of pay, hours, holidays, and classification of wireless stations, the arbitrator, after detailing the evidence taken in Sydney, determined that the minimum wage to be paid to members of the organisation in the Commonwealth public service should be as follows :—Radio engineers, class E, minimum £300, maximum £390, with annual increments of £18; radio inspectors, £380 to £420, increments £20; radio station masters in charge of continuous stations, £340 to £360, increments £20; radio telegraphists, class 4, £235 to £280, increments £15; class 5, £180 to £212, increments £12 and £10; senior radio mechanics, £252 to £276, increments £12; radio mechanics, £222 to £240, increments £6. In addition, telegraphists, class 4, in charge of non-continuous stations will receive an allowance at the rate of £25 per annum. Telegraphists, class 5, will advance to a salary of £235 after having served one year at £212, or four years in class 5. Cost of living allowances to meet the present increase in the cost of commodities and provide for other conditions arising out of the war in addition to but not as part of their salary were awarded, married officers receiving £50 per annum and unmarried officers £30 per annum. The hours of duty were fixed at 39 a week. Every employé is made liable to be called for duty at any time that he is required, but any time worked beyond the expiration of 30 minutes after the scheduled hours of duty for the day is to be paid for at the rate of time and a half for the first two and a half hours, and at double rates subsequently. There is a provision that no officer shall serve more than three years continuously in any tropical station, and an award is made for travelling allowance, disability allowance to an officer serving at a non-metropolitan station of £25 a year, recreation, leave, &c.

The arbitrator pointed out that the Institute consisted of a comparatively new body of public servants. There were now 20 stations under the control of the Commonwealth, the total staff numbering 110. The radio staff was anxious to be recognised as professional officers, and the new measure now before the Federal Parliament would abolish the distinction between the clerical and professional divisions. But dealing with the position as the law now stood, with the distinctions between the divisions in force, he was unable to admit this part of the claim. In his opinion only the radio engineers were entitled to be classed as professional men; the operating staff should be graded in the same division as land telegraphists, the clerical division.

Private Wireless in France.—The Paris journal, *La Nature*, having been asked by private owners of wireless-receiving installations whether they could employ transmitting apparatus, states that the Under Secretary for Posts and Telegraphs has issued a communication from which it appears that private persons have the option of employing transmitting apparatus. Communications established by such stations are subject to inspection by the State and to the same royalty as is charged for private wires. This royalty, as determined by the law of March 29th, 1920, is 45 fr. per year and per kilometre distance between two stations corresponding with each other (58s. per year per mile).—*Birmingham Post.*

The Electro-Harmonic Society.—The concert held on Friday last (Ladies' Night) was highly successful, and there was a very good attendance, despite the fact that the Electrical Engineers' Ball took place on the same evening; it was generally regarded as unfortunate that the two events should clash, and seeing that the dates of the concerts were known as long ago as last September, the duplication could surely have been avoided. The songs of Miss Bessie Jones and Mr. Edward Halland were particularly appreciated, and Mr. W. V. Robinson's Canadian stories and remarkable performances on the mouth-organ were equally enjoyable. Mr. Lloyd Shakespeare and Mr. Ernest Rutherford, in alliance with Miss Gladys Millage, who delighted the Society twelve months ago with their unique "musical divertissement," excelled their previous performance, and contributed very largely to the success of the concert.

Electrical Engineers' Ball.—This very successful social function was again held at the Hotel Cecil on Friday last, and we think has now so firmly established itself that we may regard it as an essential future annual event. The attendance was only slightly under last year's record figure, and but for the ravages of influenza would almost certainly have exceeded it. Many visitors from the provinces were present, and the enjoyment of the whole gathering was manifest. The music and the catering arrangements were excellent, and we feel that the heartiest congratulations should be extended to the Executive Committee, whose unselfish labours for months past made the evening such a complete success.

South Africa and Decimal Coinage.—The *South African Mining and Engineering Journal* states that the Government intends to introduce a Bill during the present session to establish a system of decimal coinage in the Union. The system is based on the division of the sovereign into 1,000 cents, with a florin worth 100 cents, as advocated for this country by the Decimal Association and the great banking companies.

Multiple Music.—By means of electrical apparatus audiences in the Futurist Kinema Theatre, Birmingham, and people in a café 280 feet away are able at the same time to hear music played in the theatre. The music is reproduced in the café through a horn after being electrically amplified. "If the Post Office will make the necessary concessions with regard to power," Mr. W. Greenfield, the resident manager of the theatre, says "wireless amateurs can enjoy our music in their own homes during the hours we are open. Telephone users may also benefit by having an additional line linking up with the theatre so that the music can be switched on when desired."—*Daily Mail.*

The Electric Welding of Steel Structures.—As mentioned in a previous issue, Major James Caldwell, M.Inst.C.E., recently read a paper on "Electric Arc Welding in Steel Structures" before the newly-formed South Wales Branch of the Institution of Mechanical Engineers. He said that in both technique and practice advances had been made. The adoption by experiment of the best forms of electrodes and fluxes for various kinds of steel, the correct voltage, current, and size of electrode for welds in materials of various dimensions were among the matters which were now calculable to a great degree of accuracy. There was still, however, plenty of room for further improvements. Tests had shown that welds in mild steel structures had a tensile strength equal to the steel itself; in fact, as a rule, the weld was slightly stronger, as was proved in tensile tests where the break occurred outside the weld. As regarded ductility, the characteristics of welds were not so good. Under alternating and impact tests welds showed up favourably, and in mild steel welds the modulus of elasticity was practically the same as that of the steel. Arc welding compared favourably with riveting with respect to the time taken up. The absence of a supply of electricity on the site was not a big handicap, as portable welding sets were easily obtainable. Arc welding also reduced the weight of the finished work, as it was generally possible to dispense with the gussets and other stiffening pieces required in riveted work. Major Caldwell gave particulars of typical cases where arc welding had been employed as an alternative to riveting, and details of tests which had been carried out upon the completed structures. These tests proved that the rigidity, generally, was greater than usually found in riveted construction.

A New Cable Ship.—The *John W. Mackay*, a telegraph cable repairing steamer, which is being constructed by Messrs. Swan, Hunter & Wigham Richardson, Ltd., for the Commercial Cable Co., of New York, was launched from the Neptune Shipyard, Walker, Newcastle-on-Tyne, on November 30th. The vessel has been specially designed for her work, and is propelled by twin-screw steam engines, which, together with the boilers, are being constructed by Messrs. Swan, Hunter, & Wigham Richardson, Ltd., at their Neptune Works. She is 360 ft. in length by 48 ft. beam by 35 ft. in depth. Her overhanging bow carries three cable sheaves, whilst a stern sheave is also fitted. The cable will be carried in four tanks placed forward of the machinery, which have altogether a coiling capacity of over 50,000 cu. ft. The machinery required for working the cables, including picking dynamometers, and a Lucas patent sounding machine, is being supplied by the Telegraph Construction & Maintenance Co., Ltd. The propelling triple-expansion engines will be supplied with steam by three boilers, working under the Howden system of forced draught, and burning oil fuel on the Wallsend-Howden system. The *John W. Mackay* was designed and built under the supervision of Commander F. H. Larnder, O.B.E., of the Commercial Cable Co.

A New Steel.—As the result of research work carried out by Mr. H. H. Ashdown and others at the Openshaw works at Manchester, Messrs. Armstrong, Whitworth & Co. have produced a steel, known as "Vibrac," which is asserted to have the valuable property of never tempering brittle and of being absolutely reliable and consistent in its behaviour under any normal treatment, says *The Times*, which goes on to explain that what is claimed for "Vibrac" steel is, that in addition to the fact that it responds satisfactorily to even higher mechanical requirements, particularly with respect to elastic limit, than those obtained from nickel chrome steels, it may, subject to any normal treatment, after tempering, be either furnace cooled or cooled in air, thus cutting out all risks of distortion, and yet will give higher impact values than nickel chrome steel treated under the most favourable conditions. Further, in large masses it is consistent throughout the mass.

Summer Time.—A Bill presented by the Home Secretary on February 8th provides that Summer Time shall begin at midnight on the night of the last Saturday in March (or the last Saturday but one in March when the last Saturday is the day preceding Easter), and shall terminate at midnight on the night of the first Sunday in October. These dates were fixed in agreement with France and Belgium, in order to obviate the inconveniences which have been experienced in the past through Summer Time beginning and ending on different days in the different countries. The Bill makes the arrangement, which has hitherto been carried out under Orders in Council, a permanent one.—*The Times.*

An International Scientific Congress.—The Association des Ingénieurs sortis de l'Ecole de Liége is organising for the week June 11th to 16th, 1922, on the occasion of the 75th anniversary of its foundation, an International Scientific Congress, to which the engineers and scientific men of Belgium and the allied nations are invited. The Congress will comprise seven sections: mines, metallurgy, mechanics, electricity, chemical industries, civil engineering, and geology. Papers will be read and discussed, and reports will appear in the *Revue Universelle des Mines*. A list of suitable subjects has been drawn up by way of suggestion, but the scope of the Congress is not restricted to these; the list can be obtained, together with additional information regarding the Congress, from Mr. O. Lepersonne, Secrétaire-Général de l'A.I.Lg., 16, Quai des Etats-Unis, Liége. A copy of the list of subjects is on file at the office of the Electrical Review.

An Educational Film.—An interesting kinematograph film of great educational value was shown recently at the Polytechnic, Regent Street, London, to the students of the Day School of Engineering. This film, which was kindly loaned by the British Thomson-Houston Co., Ltd., showed the stages in the construction of a 40-000-h.p. Curtis turbo-alternator at the company's works at Rugby. Before the film was presented, Mr. H. J. Spooner, head of the School of Engineering, impressed upon the students the importance of screen projection, both moving and stationary, in conjunction with lecture work. Mr. Philip Kemp, head of the electrical engineering department, pointed out the rapid growth in the size of the plant, mentioning that this turbo-alternator was the largest set manufactured in Great Britain. Mr. Kemp then explained the use of these large sets in super-stations and the great increase in consumption of electricity that was to be expected consequent upon the formation of supply areas in England and Wales.

The film commenced with the foundry work on the turbine casings, and then took the spectators through the various processes of construction to the static and dynamic balancing of the turbine and alternator rotors, concluding with some striking illustrations of the magnitude of the power of the set.

The Vulcanisation of Rubber.—A paper on "Vulcanisation, Past, Present and Future," was read by Dr. Schidrowitz before the Institute of Rubber Industry on January 11th.

After describing the different methods of factory practice now in vogue, Dr. Schidrowitz turned to the future and described the Ideal-Omnium Rubber Works, Ltd., A.D. 1940—"Compared with the works with which I had been familiar," he said, "in the first and second decades of the nineteenth century, the exterior struck me as having indeed a strange appearance. First, there were no chimneys. My guide, with a pitying smile, explained that there were no chimneys because they had no boilers.

"'Each mill and calender,'" he said, "'is connected with its own small boiler; this is electrically heated and fitted with an automatic cut-out, which operates when the mill or calender has attained a definite heat. Subsequently the temperature is kept steady by a stream of warm water from a central tank. The latter is heated by means of powerful electrical elements and is fitted with delicate thermostats.'

"Everywhere—even in the mill rooms with their enclosed mixers and silent gears—one saw or felt that curious absence of the characteristics of the 1920 factory—noise, steam, solvent vapours, the dust of fillers. Above all, there was the evidence at every turn of electric power—electric power for heating shops and for heating mills, water, gases— electric drive for every machine, for runways—electric light for illumination and for some kinds of curing.

"'Tell me,' I said to my guide, 'how it is that you are able to use electricity so lavishly.'

"'It costs us,' he replied, 'about one-sixteenth of a penny per unit. On every coalfield there have been erected super-power stations, costing many millions apiece; several super-stations are worked by tidal power; the loss in transmission has been reduced to a minimum.'

"'But the capital cost,' I said, 'must have been enormous; what of the consequent overhead charges?'

"'Ah, yes,' he replied, 'but the capital cost was defrayed out of the economies effected by a drastic reduction of the income-tax in 1922. . . .'

"And then I woke up."—*Financial Times.*

The Design and Industries Association.—This Association is holding a "Deliverance from Drudgery" exhibition at 6, Queen Square, W.C.1, from February 6th to 25th. There is to be a conference on lighting at 8 p.m. on February 20th.

The Enlargement of Olympia.—According to the *Daily Mail* the extension of Olympia is contemplated, and will be carried out in a short time. It is proposed to build another hall half the size of the present one; the two halls will be self-contained, and will, therefore, be employed separately or together for exhibitions.

Exhibition at Reval.—The annual Agricultural and Industrial Exhibition at Reval will be held from September 2nd to 11th this year, according to the *Board of Trade Journal*. The organising body is the Esthonian Agricultural Association, 20, Nunne Street, Reval.

Automatic Train Control.—According to Mr. James B. Regan, head of the Regan Safety Devices Co., who has left London for New York, 49 railway companies in the United States have been ordered by the Government to install automatic train control by not later than July 1st, 1924, says *The Times*. A number of tests and demonstrations of automatic train controlling appliances have been made in this country and in France during the past few years, and the Ministry of Transport is known to be interested in the subject. A satisfactory device of this sort not only links the locomotive with the signals so that the train obeys them, independently of the driver, but automatically applies the brakes if another train or any other obstruction is on the line, whether visible to the driver or not. The Regan system was fully illustrated and described in our issue of October 29th, 1920, p. 570.

The Glasgow Subway.—The Glasgow underground railway is to be closed owing to its inability to meet working costs out of revenue. It has been handicapped by being in competition with the finest tramway system in the world. Electrification has been suggested again and again, but it is improbable that even this would remedy the position of the undertaking.

Electric Cranes.—The Anchor Line has introduced electric cranes to replace those driven by steam at the Yorkhill berth, Glasgow. They have been so constructed that very little dock space is taken up; they are of the overhead type, and the work of moving wagons on the quay will be greatly facilitated.

Radium in the Belgian Congo.—The *Westminster Gazette* reports the discovery of rich radium (uranium?) deposits at Katanga, in the Belgian Congo. The existence of radium in the country was known before the war, according to an official of the Union Minière du Haut Katanga.

A New Water-boiler.—According to the Sydney *Daily Telegraph*, a young Australian electrician has invented a utensil which will boil a pint of water in 25 seconds. "The secret of the principle has been well kept. It is one which is in direct opposition to all the accepted ideas of electrical science. An expert, when told of the scheme, said that it simply could not be done, because the basis violated a cardinal principle of science. The expert, when present at the demonstration, revised his criticism, and is now said to be pondering over the fallacy of accepting as final text-book diagrams.

An Indian National Electrotechnical Committee.—The Government of India is to constitute a National Electrotechnical Committee, consisting of Mr. A. S. Coubrough (of Messrs. Mather & Platt, Ltd., Calcutta), Mr. A. Cochran (of Messrs. Burn & Co., Calcutta), Mr. Hindley (chairman of the Port Trust, Calcutta), for the purpose of discussing points of interest to the country and forwarding its resolutions to the International Electrotechnical Commission in London. The Institution of Engineers (India), according to the Government, will ultimately have the charge of appointing the National Electrotechnical Committee.—*Reuter's Trade Service* (Bombay).

Sampling and Analysis of Coal Committee.—The Fuel Research Board of the Department of Scientific and Industrial Research has appointed a committee to advise upon the sampling and analysis of coal. The personnel of the Committee is as follows:—Prof. Thomas Gray, D.Sc., Ph.D. (chairman), Prof. J. W. Cobb, C.B.E., B.Sc., Mr. J. T. Dunn, D.Sc., Mr. J. S. Flett, O.B.E., D.Sc., LL.D., F.R.S., Mr. G. Nevill Huntly, B.Sc., Mr. S. Roy Illingworth, M.Sc., Mr. J. G. King, F.I.C., Mr. C. H. Lander, D.Sc., Mr. R. Lessing, Ph.D., Mr. C. A. Seyler, B.Sc., Mr. F. S. Sinnatt, M.B.E., M.Sc., Prof. R. V. Wheeler, D.Sc., Miss N. Renouf, F.C.S. (secretary).

It is intended that the methods recommended by the Committee shall be adopted in connection with the physical and chemical survey of the national coal resources. Communications for the Committee should be addressed to the secretary at 16 & 18, Old Queen Street, Westminster, London, S.W.1.

Direct Current at 200,000 Volts.—The General Electric Co. of America announces the development of a complete outfit for producing 2 kW of direct current at 200,000 V. This outfit consists of the following apparatus:—A 10-h.p. motor coupled to a 2,000-cycle alternator; a main transformer; four 10,000-volt kenotrons; four filament transformers; two 100,000-V condensers; and a switchboard.

The Wimbledon Case.—Petitions signed by a large number of burgesses of the town, requesting the Mayor to call a town's meeting to consider the situation which has arisen in connection with the dismissal of Mr. H. Tomlinson Lee, have been handed to the town clerk, with a request that he will obtain the Mayor's decision as to whether or not he will call a town's meeting. In the event of his refusal, steps will be taken to call a meeting of the burgesses.

Appointments Vacant.—Electrical engineer and business manager, for the Belfast Corporation electricity undertaking; assistant electrical engineer (£250), for the Tonbridge Corporation electricity department. (See our advertisement pages to-day.)

INSTITUTION NOTES.

The Institution of Electrical Engineers.—Informal Meeting.—At the informal meeting on February 6th Mr. A. F. Harmer was in the chair, when Mr. J. Joseph read a paper on "Some Practical Applications of the Thermionic Valve," and briefly outlined some of the recent applications of the valve apart from wireless telegraphy and telephony. He described the construction of the valves and showed large diagrams of wave forms and some excellent exhibits of the valve in its different applications. One of the most important applications of the valve, he said, was in connection with repeater circuits for the amplification of telephone currents in long-distance trunk telephone cables. The weight of a conductor used to be from 200 to 600 lb. per mile, but by the employment of the thermionic repeater relay, the weight was now reduced to 20 lb. per mile—a saving of many thousands of pounds in a network of long trunk lines. The thermionic relays were placed thirty miles apart, and comprised three special transformers. Another interesting application of the valve for the amplification of low-frequency sounds had recently been developed in connection with the recording of heartbeats, so that in conjunction with the thermionic amplifier the beat of the heart could be heard in a large room, and, what was very important, without the patient being aware of it and possibly getting excited. Another recent application was the simultaneous reproduction of speech with the projection of a film on a screen. A somewhat novel application was its use as a high resistance for the measurement of dielectric losses in cables at high potentials by the wattmeter method. Rectifiers for charging batteries were next reviewed, and in his concluding remarks the author said that the thermionic valve might be indirectly used for controlling mechanical work even at distances of thousands of miles. It was gratifying to know that the best valves were produced in this country. The subsequent discussion was led by Mr. P. Dunsheath, who spoke of the application of valves to breakdown tests on cables. He was followed by Mr. S. R. Mullard, Prof. P. M. Baker, Prof. C. L. Fortescue, Mr. Leslie Miller, Mr. E. Kilburn-Scott, Major Tucker, Messrs. P. Coursey, C. A. Newell, Robinson, A. Rosen, Bell, and A. F. Harmer.

Commemoration Meetings.—The following is the programme of the meetings to be held on February 21st, 22nd and 23rd, in commemoration of the first meeting of the Society of Telegraph Engineers held on February 28th, 1872:—

Tuesday, February 21st (at 3 p.m.).—Experimental lecture by Professor J. A. Fleming, M.A., D.Sc., F.R.S., on "Michael Faraday and the Foundations of Electrical Engineering."

(The annual dinner of the Institution will be held this day at the Hotel Cecil, Strand, W.C., at 7 p.m. for 7.30 p.m.

Wednesday, February 22nd (3.30 to 6 p.m.).—Short discourses on "Reminiscences and Experiences of Electrical Engineering in both its Technical and Legislative Aspects."

Wednesday, February 22nd (8.30 p.m.).—Professor Fleming will repeat his lecture of the previous day.

Thursday, February 23rd (3.30 to 6 p.m. and 8 to 10 p.m.).—Further discourses on "Electrical Engineering."

We give below the list of speakers at the three sessions to be devoted to "Reminiscences and Experiences of Electrical Engineering":—

Wednesday, February 22nd (3.30 p.m.).—Colonel R. E. Crompton, C.B., R.E., who will be followed by:—

Mr. S. Evershed.	Sir Alexander Kennedy, F.R.S.
Mr. E. Garcke.	Sir Oliver Lodge, D.Sc., F.R.S.
Mr. W. Judd.	Lord Parmoor.
Dr. G. Kapp.	

Thursday, February 23rd (3.30 p.m.).—The Hon. Sir C. A. Parsons, K.C.B., F.R.S., who will be followed by:—

Mr. Frank Bailey.	Mr. J. H. Holmes.
Sir T. O. Callender.	Mr. W. H. Patchell.
Dr. S. Z. de Ferranti.	Mr. J. Swinburne, F.R.S.

Thursday, February 23rd (8 p.m.).—Mr. J. E. Kingsbury, who will be followed by:—

Mr. Ll. B. Atkinson.	Mr. A. A. Campbell Swinton, F.R.S.
Mr. B. M. Drake.	Mr. A. H. Walton.
Sir William Noble.	Mr. C. H. Wordingham, C.B.E.
Mr. G. W. Partridge.	Mr. A. Wright.

Together with the remarks of the above, written contributions from the following will be published in a special Commemoration Number of the *Journal* of the Institution:—

Mr. O. H. Baldwin.	Mr. F. E. Gripper.
Mr. G. Balfour, M.P.	Mr. H. Hirst.
Sir Charles Bright, F.R.S.E.	Sir J. Kemnal.
Mr. R. A. Chattock.	Mr. C. Faraday Proctor.
Mr. H. Edmunds.	Mr. A. Siemens.
Sir K. Elphinstone, K.B.E.	Mr. C. P. Sparks, C.B.E.
Mr. W. B. Esson.	Mr. J. C. Vaudrey.
Sir R. T. Glazebrook, K.C.B., F.R.S.	

South Midland Centre.—Owing to the resignation of Mr. J. D. Morgan, the Committee has appointed Capt. H. Hooper to the post of hon. secretary, and all communications in future should be addressed to:—Capt. H. Hooper, 13, Phœnix Chambers, Colmore Row, Birmingham ('Phone, Cent. 12).

Institution of Civil Engineers (Ireland).—At a meeting of this Institution, recently held in Dublin, Mr. G. Marshall Harriss, general manager Dublin United (Electric) Tramways Co., read an interesting paper on "Electric Welding," urging

that the process was now so important that no mechanical workshop could afford to be without a plant. He traced developments during the war, and, referring to the introduction of the system into the Dublin Tramways works in 1919, said that but for its use the cars could not have been kept on the streets, because it was almost impossible to get steel castings. Now, castings which in former days were thrown away were repaired by welding, which resulted in a great saving.

Birmingham and District Electric Club.—A paper was read by Mr. G. C. A. McDonald upon "Illumination from the User's Point of View." The lecturer stated that casual observation of private houses, offices, works, and shop windows showed what a vast, practically untilled field there was for electrical engineers who would specialise in scientific illumination. The lecturer gave a detailed account of recent investigation of the known laws dealing with the use of light reflectors. He laid great stress upon the correct diagnosis of the quantity and quality of light required for each specific purpose, and gave the methods upon which sound lighting schemes could be devised.

Greenock Association of Electrical Engineers.—On February 8th Mr. H. Emmitt read a paper on "Electric Mains." With efficient drainage, the lecturer favoured the "draw-in" system of cable laying. Fault localisation was dealt with at considerable length, and proved the subject of some discussion. The skill required by the mains engineer was illustrated by lantern slides, which showed the surmounting of various obstacles in the way of cable-laying in busy thoroughfares.

Röntgen Society.—Sir Oliver J. Lodge will deliver the fifth Silvanus Thompson Memorial Lecture at a special meeting of members of the Society on March 21st at the Institution of Electrical Engineers.

Junior Institution of Engineers.—The annual dinner and ladies' night of the Midland Section was held on January 31st, Mr. R. B. Asquith-Ellis, A.M.I.Mech.E., in the chair. Covers were laid for some 70 members, ladies, and guests; and after an excellent repast and following the toast of "The King," Dr. C. C. Garrard (vice-president Midland Section) presented a large electric gong to the Section on behalf of the General Electric Co. Mr. Ellis accepted the gong in the name of the Midland Section, and called on Mr. E. C. R. Marks, M.I.Mech.E., to propose the toast of "The Institution." Mr. Marks, in the course of his speech, mentioned how the Institution differed from the general practice of the senior Institutions and how these Institutions had looked to the "Juniors" for suggestions, notably in connection with the formation of local sections. The toast was replied to by Mr. W. A. Tookey, M.I.Mech.E. (hon. treasurer), who gave a *resumé* of the work of the Institution, and remarked on its steady growth. Other toasts were the "Midland Section," proposed by Principal Schofield, M.B.E. (chairman of Loughborough Section); "Kindred Associations," proposed by the president and seconded by Mr. R. A. Chattock, M.I.E.E.; "Our Guests," proposed by Mr. G. W. Costain (past chairman of the Section) and replied to by Mr. Hyde (vice-president of the Sheffield Section); and "The Ladies," proposed by Mr. E. M. Boote (vice-chairman of the Section) and replied to by Mrs. R. B. A. Ellis. The musical side of the programme was excellent, and items were rendered by Mrs. Harper, Messrs. Owen, Granville, Boote, and Crisp.

Liverpool Engineering Society.—The annual dinner of the Society was held on February 2nd, the company including the Lord Mayor of Liverpool (Alderman C. H. Rutherford) and Major-General Sir Lothian Nicholson. Mr. J. B. Wilkie (president of the Society) referred to the high cost of transport, and said there was a splendid opportunity of widening and deepening the canals by means of labour which was at present unemployed. There was no more economical means of transport. It was a great pity that the canals were ever allowed to be controlled by the railways. He hoped that every opposition would be made to the railways obtaining powers for road transport, because if they got these powers they would do what they had done with the canals and force all traffic to go by the railway.—*The Times.*

Willesden Polytechnic Electrical Engineering Society.—The annual general meeting of this Society was held at the Polytechnic on Saturday last, the chairman on this occasion being Mr. Frederic H. Taylor, the life-president and founder. (The Society was founded on February 4th, 1902.) The hon. secretary (Mr. A. J. Wheeler) brought forward an excellent report of the year's working, the feature of which was the recent appreciable increase in membership. A very good programme of papers and also visits to works have been arranged for the remainder of the winter session.

Edinburgh Electrical Society.—At an Apprentices' Night, held on February 10th, two papers were read: "The Ljungstrom Turbo-Alternator," by Mr. Robert Carse, and "Searchlights," by Mr. James Heatherill. Several new patterns of combined heating plugs and switches were submitted to the meeting and their advantages discussed.

British Electrical Development Association, Inc.—The annual general meeting will take place on Wednesday, February 22nd, and will be followed by the annual luncheon at the Hotel Cecil, at one o'clock p.m. The chair will be taken by Mr. Councillor E. C. Ransome, O.B.E., J.P. (President-elect. E.D.A.), and other speakers will include Mr. Arthur Neal, M.P., Mr. Hugo Hirst (president), Mr. J. S. Highfield, Sir Archibald Denny, and Mr. A. F. Berry (chairman of council).

Institute of Cost and Works Accountants.—A meeting is to be held on February 22nd at the Institute of Chartered Patent Agents. Mr. J. C. Todman, A.M.I.Mech.E., will speak on "Some Units of Measurement."

An inaugural London Branch meeting will be held at the above hall on February 28th. Mr. J. M. Fells, C.B.E., will preside.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mme. CURIE was elected, on February 7th, a Free Associate Member of the Academy of Medicine in room of the late Edmond Périer, director of the museum. By the voluntary withdrawal of her male rivals, Mme. Curie remained the sole candidate, says *The Times.*

Swindon T.C. has appointed Mr. NICKLIN, of that town, as electrical and mechanical engineer, at a commencing salary of £500 per annum.

We regret to record that Mr. F. H. RUDD, borough electrical engineer of Rochdale, was one of seventeen passengers injured in a tramway smash which occurred in the town on February 9th.

Mr. T. M. JORNSON, A.M.I.E.E., late of the English Electric and Siemens Supplies, Ltd., and previously for 17 years with Cammell Laird & Co., Ltd., has been appointed branch manager of Messrs. Drake & Gorham Wholesale, Ltd., at their Liverpool office, 61a, Bold Street.

Owing to the growth of the Electrical Wholesalers' Federation, Ltd., and the work entailed, Mr. A. G. BEAVER, who has been hon. secretary for the past seven years, finds that he is no longer able to devote the time necessary to look after the Federation interests. Mr. Reginald Cooper, who has had considerable experience in association work, has been appointed general secretary, and the registered offices of the Federation will now be located at 19/21, Hatton Garden, E.C.

Mr. ERNEST HATTON, general manager of Newcastle-on-Tyne Corporation tramways, has announced his intention to retire, owing to ill-health. Mr. Hatton has served the Corporation for seventeen years.

Obituary.—SIR GEORGE CARTER, K.B.E. — The death occurred, on February 9th, of Sir George Carter, K.B.E., for some years managing director of Messrs Cammell, Laird & Co., Ltd. He was a popular figure in the shipbuilding world, and during the war was chairman of the Shipbuilding Advisory Committee.

MR. S. R. BLUNDSTONE.—We regret to record the death of Mr. Samuel Richardson Blundstone, a member of the Council of the British Electrical Federation, Ltd., and a director of some of the B.E.T. companies. He passed away on February 12th in London, at the age of 63 years.

NEW COMPANIES REGISTERED.

Skirving Rutherford Institute, Ltd. (179,499).—Private company. Registered February 4th. £500 in £1 shares. To carry on the business of medical electricians, Swedish masseurs and chiropodists, makers of and dealers in reclining electric-light baths, and other apparatus, &c. The subscribers (each with one share) are:—W. Skirving Rutherford, 29, Tottenham Court Road, W.1, medical electrician and masseur; Amy Bernard, 16, Chapel Street, W.C.1, masseuse. The first directors are not named. Registered office: 17, Bishop's Road, Paddington, W.

Leicester Electrical Engineering Co., Ltd. (179,533).—Private company. Registered February 7th. Capital, £2,000 in £1 shares. To acquire the businesses of electrical engineers carried on (1) by T. Baker at 93, Upperton Road, Leicester, as T. Baker & Co., and (2) by W. H. French at 346, Humberstone Road, Leicester, as W. H. French, and to carry on the business of manufacturers of and dealers in electrical material, goods and appliances, electrical and other automobile accessories, &c. The permanent directors are:—T. Baker, 93, Upperton Road, Leicester; W. H. French, 149, Barclay Street, Leicester. Qualification, £100. Secretary: W. C. Quinn. Registered office: 11, Bowling Green Street, Leicester.

Metal Electrical Syndicate, Ltd. (179,561).—Private company. Registered February 8th. Capital, £7,500 in £1 shares. To acquire interests in any invention relating to electrical deposition of metals, and to carry on the business of electroplaters, sherardisers, manufacturers, smelters, and annealers and founders of, and dealers in, ferrous and non-ferrous metals and alloys, &c. The subscribers (each with five shares) are:—A. E. Mawn, 8, Sylvia Gardens, Wembley, solicitor; S. J. Quinn, 9, Terroot Road, West Green, N., clerk; G. P. Millard, 30, Audrey Road, Ilford, E., clerk; A. E. Brain, 50, Perrers Road, Hammersmith, W., clerk. The first directors are not named. Registered office: Westminster House, 7, Millbank, S.W.1.

Industrial Intelligence.—Industrial Intelligence, Ltd., has been registered as a company limited by guarantee, without a capital divided into shares. The objects are: to promote publicity and propaganda of all kinds, especially such as may be calculated to foster production, manufacture, and trade in and between all parts of the British Empire and other countries; to promote and assist the production and distribution of literature, printed matter, photographs, illustrations and advertisements, and billposting of all kinds; to organise meetings, lectures and exhibitions; to establish and conduct commercial agencies, &c. The company is to be governed by a Council of not more than six members, two being elected annually at the general meeting and one nominated by each of the following bodies: The Federation of British Industries, the British Electrical and Allied Manufacturers' Association, the Cable Makers' Association, and the British Engineers' Association. The first members are:—Llewellyn B. Atkinson, Alster, Little Hampden, Great Missenden, Bucks, electrical engineer; Roland T. Nugent, 21, Egerton Gardens, S.W. 3, director, Federation of British Industries; D. A. Bremner, 9, Rossetti Garden Mansions, Chelsea, S.W., director, British Engineers' Association; D. N. Dunlop, Onslow Village, Guildford, director, British Electrical and Allied Manufacturers' Association. Each of the above-mentioned organisations shall be entitled to become the first "Association" members without election, and the signatories to the Memorandum of Association the first "ordinary" members. The registered office is 24, Chancery Lane, W.C. The file number is 179,507.

Freeland White & Co., Ltd. (179,611).—Private company. Registered February 10th. Capital, £3,000 in £1 shares. To carry on the business of mechanical, electrical, telephonic and general engineers, electricians, &c. The subscribers are: P. F. White, 73, Great Portland Street, W.1, electrical engineer, 1,000 shares; J. Reynolds, 16, Mayhill Road, Charlton, S.E.7, clerk, 50 shares. The first directors are not named. Remuneration as fixed by the company. Solicitors: Chamberlayne, Hackins & Co., 83, Pall Mall, S.W.

Irish Automatic Telephone Installation Co., Ltd.—Private company. Registered in Dublin February 11th. Capital, £10,000 in £1 shares (5,000 8 per cent. cumulative preference). To carry on business as indicated by the title. The first directors are: T. Wm. Delany, Main Street, Longford, solicitor; K. J. Kenny, 65, Middle Abbey Street, Dublin, advertising agent; J. P. Dillon, 25, Suffolk Street, Dublin, solicitor. Secretary: A. Channing. Registered office: 8, Nassau Street, Dublin.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Llanelly and District Electric Lighting & Traction Co., Ltd.—Trust deed dated January 24th, 1922, to secure £125,000 debenture stock charged on electricity supply and light railway undertaking, leasehold hereditaments, and the company's undertaking and property, present and future, including uncalled capital. Trustees: Utilities and General Trust, Ltd.

Ellerd Styles & Co., Ltd.—Debenture, dated January 20th, 1922, to secure £600, charged on the company's undertaking and property, including uncalled capital. Holder: H. R. Morris, Hill House, Montague Road, Felixstowe.

Victoria Electrical (Manchester), Ltd.—Particulars of £7,000 debentures, authorised January 26th, 1922; present issue £6,250; charged on the company's undertaking and property, present and future, including uncalled capital.

A. Reyrolle & Co., Ltd.—Satisfaction in full on various dates to December 31st, 1921, of debentures dated June 6th, 1907, securing £7,500.

Mitchells' Electrical and Wireless, Ltd.—Particulars of £550 debentures, authorised January 16th, 1922; whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

CITY NOTES.

Yorkshire Electric Power Co.

The report for 1921 shows a net profit of £74,316, against £64,740 in 1920. The balance brought forward was £20,939, making £95,255. The 6 per cent. dividend on the preference capital absorbs £11,409; 8 per cent. on the ordinary capital will require £45,586; £15,000 is to be put to reserve, and £23,260 carried forward. Notwithstanding the difficulties of the year (coal stoppage and trade depression), the profit shows a substantial advance over 1920. Existing installations made a decreased demand, but economies were effected in production, and new consumers brought additional load. The Thornhill and Barugh power station extensions were delayed by the coal stoppage, but they are now proceeding satisfactorily, and will be giving supply within the next few months. Extensions of mains and sub-stations have been made for bulk supply to Dewsbury, Todmorden, Elland, and Honley and to meet the requirements of new consumers. During the second half of 1921 there was a substantial reduction in the price of electricity to customers, following the price of coal, in terms of their agreements. The report goes on to refer to the inquiry held by the Electricity Commissioners last May regarding the Aire and Calder district, and it states that the Commissioners have now authorised the company to construct its Ferrybridge power station and have decided that no other capital power station is to be established in the district for the present. They, moreover, propose that in a large part of the company's area the company shall exercise the powers of supply of a joint electricity authority, and that in the remainder of the company's area within the district agreements shall be come to with the large municipal electricity undertakings as to the company's distributing powers and the interlinking of the company's Thornhill and Ferrybridge stations with the important municipal stations in the district. The details of this arrangement are under discussion. The directors regard the proposals of the Commissioners as endorsing and confirming in important respects the policy which the company has pursued in the past. In the southern part of the company's area (which is comprised in the North-East Midlands Electricity District) the decision of the Commissioners regarding the future development of supply is still to be given. In this part of the company's area there are two important municipal undertakings, those of the Sheffield and Rotherham Corporations. With both of these the company has entered into arrangements for joint working in the interests of cheap production. An inter-connection has already been made with the Sheffield Corporation undertaking for a substantial amount of current. The amount of 5½ per cent. redeemable debenture stock has been increased to £360,000 by the issue of a further £130,000 of stock, which was readily applied for. A Bill has been deposited in Parliament whereby it is proposed to convert into shares of £1 denomination the company's £10 ordinary and £5 cumulative preference shares. In the event of authority being obtained the present share certificates will be exchanged at the rate of ten £1 ordinary shares for each ordinary share and five £1 cumulative preference shares for each £5 preference share. Owing to the rapid growth of the company's operations, further capital is required, and at the extraordinary meeting called to follow the general meeting on February 21st assent will be asked to a resolution authorising the issue of further cumulative preference shares. To provide for future extensions it will be necessary to obtain the authority of Parliament to increase the authorised capital. Steps are being taken to raise this from £2,000,000 to £4,000,000 with power to borrow on mortgage or by the issue of debenture stock up to one-third the increased amount. Mr. Howard C. Levis, who has been a director since 1909, has resigned. Mr. R. W. Wickham and Mr. R. G. Ellis have been appointed directors.

North Metropolitan Electric Power Supply Co.

Net revenue for 1921, £125,333, against £96,175 for 1920. Including interests and dividends received and the balance of £4,433 brought forward, the total is £136,128. From this are deducted: mortgage and other interest, £31,980; mortgage and debenture funds, £3,142; to reserve, £25,000: leaving £76,007. A dividend of 6 per cent. on the preference shares absorbs £35,999, and a dividend of 10 per cent. on the ordinary shares, £35,002, leaving £5,006 to carry forward. Units sold show a decrease of approximately 6 per cent. as compared with 1920; this decrease is due to loss of industrial load owing to unsettled trade conditions and the coal strike. A new agreement has been entered into with the Stoke Newington Borough Council for a supply in bulk on revised terms. A bulk supply has been given to Welwyn Garden City, Ltd., since October, 1921. It is expected that a supply will be given to Cheshunt and Ware early this year. An additional 5,000 kW turbo-alternator has recently been installed, and two further 5,000-kW sets are on order for the Brimsdown power station. A 5,000-kW Ljungstrom turbo-alternator has been ordered for the Willesden power station. This new generating plant should be in service in the course of this year.

An issue of £228,460 7½ per cent. debenture stock, made early in July, was many times over-subscribed. It will be necessary to make a further issue of capital at an early date (£250,000 second preference stock, 8 per cent.), to provide for the normal expansion of the business, and notice of an extraordinary meeting in connection with this matter has been issued.

The Electricity Commissioners have issued a statement of their decisions on the schemes submitted at the inquiry held by them in June and July, 1921. The company's area of supply will be included in the district of the new Joint Electricity Authority which it is proposed to set up, but the Commissioners state that in drafting their Order establishing that authority they will provide that the rights of the company are not to be interfered with, and the supply powers of the Joint Authority in the company's area will be carried out by the company.

A Bill has been deposited in the present Session of Parliament to provide for revision of methods of charge and prices for electrical energy, the vesting in the company of the undertakings of the North Metropolitan Electrical Power Distribution Co., Ltd., the dissolution of that company and for other purposes.

The business of the North Metropolitan Electrical Power Distribution Co., Ltd., continues to make satisfactory progress and a dividend of 4 per cent. on its ordinary shares for the year 1921 has been declared.

Electrolytic Zinc Co. of Australasia.

The report for the year ended June 30th, 1921, states that the period was mainly one of construction. The first half of the plant, with a capacity of 15,000 h.p., was put into commission in November last. A total of 30,000 h.p. of electricity will be required in all, and it is hoped that the works will be in operation before the end of the present year. A twenty-year contract for the supply of power has been entered into with the Tasmanian Government; this may be extended for a further 20 years at the company's option. A certain and abundant supply of zinc concentrates has been assured from several sources.

The Board reports the sale of £400,000 8 per cent. first mortgage debentures at £95 per cent. These have a currency of 20 years, and with them will be issued option certificates carrying the right, until December 31st, 1923, to take up 400,000 preference shares.

London Underground Railways.

Metropolitan District Railway Co.—Full dividend on the second preference stock and a dividend on the ordinary stock for the year ended December 31st, 1921, of 1 per cent.; to reserve, £65,000 (an addition of £20,000 compared with the previous year. Carrying forward £60,500.

London Electric Railway Co.—Final dividend on the ordinary shares of 1¾ per cent., making a total of 3¼ per cent. for 1921. Carrying forward £39,700.

City & South London Railway Co.—Final dividend on the consolidated ordinary stock of 1¼ per cent., making 3¼ per cent. for 1921. Carrying forward £25,000.

Central London Railway Co.—Final dividend on the undivided stock of 2 per cent., making 4 per cent. for the year. Final dividend on the preferred ordinary stock of 2 per cent., making 4 per cent. for 1921, and a dividend for 1921 on the deferred ordinary stock of 4 per cent. £59,600 carried forward.

Underground Electric Railways Co. of London.—Subject to final audit, the revenue will enable the company to pay the full interest to December, 1921, on the 6 per cent. first cumulative income debenture stock and to pay interest at the rate of 2 per cent., free of tax, on the 6 per cent. income bonds of 1948 for the half year ended December, 1921. Carried forward, £26,000.

London Tramway Companies.

London & Suburban Traction Co., Ltd.—It is proposed to pay 3¼ per cent. in respect of arrears on the 5 per cent. cumulative preference shares. £11,523 is carried forward, compared with £1,205.

Metropolitan Electric Tramways, Ltd.—A dividend of 7 per cent. is being paid on the 5 per cent. cumulative preference shares; this represents a balance of 4½ per cent. for 1919 and 2½ per cent. in 1920. After placing £67,500 to reserve for reconstruction and renewals, £2,420 is carried forward, compared with £1,538 brought in.

South Metropolitan Electric Tramways & Lighting Co., Ltd.—Dividends are announced of 6 per cent. on cumulative preference shares and 7½ per cent. on ordinary shares for year ended December 31st, 1921. £15,000 is transferred to reserve for renewals and reconstruction, and £2,864 is carried forward, as compared with £1,556 brought in.

St. James' & Pall Mall Electric Light Co., Ltd.

The connections increased from 19,904 kW to 21,167 kW during 1921, and 13,464,418 units were supplied to consumers. Net profit, £31,232, plus £5,886 brought forward. Preference dividend (7 per cent.), £7,000; ordinary dividend (total for the year, 12 per cent.), £24,000; carried forward, £6,119. The directors report that:—

> The Electricity Supply Bill referred to in the last report was re-introduced in the Session 1921, but made no progress; should a similar Bill be introduced during the coming session, your directors will take such steps as may be necessary to protect your interests. In June and July of the past year the Electricity Commissioners held an inquiry on the schemes which had been submitted for the improvement in the supply of electricity within the area provisionally determined by them. The London Electricity Joint Committee, 1920, Ltd., in which your company is a shareholder, was represented, and gave evidence. The Commissioners have made a report, in which they have indicated the lines on which a scheme will be framed, but neither the London Electricity Joint Committee, 1920, Ltd., nor your directors are satisfied with their suggestions. Meanwhile, negotiations are proceeding in an endeavour to arrive at a satisfactory solution of the problem. Any scheme will need to be carefully considered in the interests of the company, and your board are taking steps to do this, and will not assent to any scheme until it has been approved by the shareholders.

London Electric Supply Corporation, Ltd.

Profit for 1921, £102,286, against £99,487 for the previous year. Add brought forward, £14,257. Interest on temporary loan, &c., £2,116; debenture interest and sinking fund, £40,074; preference dividend (6 per cent.), £26,952; dividend of 4 per cent. on the ordinary shares, £13,320; reserve, £15,000; contingencies, £5,000; carry forward, £14,081. Sinking fund for redemption of debenture stock in 1931 now amounts to £171,595, in addition to £62,180 shown in the capital statement under the agreement with the St. James' and Westminster Companies. Units sold, 47,490,802, against 47,366,351 in 1920. Total costs per unit sold 1.47d., as against 1.38d. Average receipt per units sold (lighting and power), 1.91d., as against 1.81d. The report contains the reference to the Electricity Commissioners' inquiry, &c., given in the St. James' report above.

Metropolitan Railway Co.

The total net income for 1921 was £750,946, plus £15,416 brought forward. Interest, rentals, and other fixed charges and appropriation to renewals absorb £342,052; dividends on preference stock, £239,107. A final dividend at the rate of 3¼ per cent. per annum for the last half-year, making 2½ per cent. for the year, is recommended, carrying forward £17,797. For 1920 the dividend on the ordinary stock was 30s. per cent., and £15,416 was carried forward. Trade depression and unemployment seriously affected the traffic, but there are now signs of improvement, and economies are being effected in all branches of expenditure. A considerable traffic is expected to result from the British Empire Exhibition at Wembley Park in 1923. During 1921 four powerful steam locomotives were placed in service, and 47 new electric cars were delivered. Three of the electric locomotives had been re-equipped with higher-powered motors and are now working, and all the other electric locomotives owned by the company are gradually being dealt with in a similar manner. A switch-house to accommodate the new switchgear required for the augmented generating plant at Neasden is being erected, and the work of installing that plant is progressing satisfactorily.

Cordoba Light, Power and Traction Co., Ltd.

In the Chancery Division, on February 7th, Mr. Justice Astbury sanctioned a scheme of arrangement between the company and its debenture-stock holders, loan creditors who held promissory notes, and the preference shareholders. Mr. Jenkins, K.C., for the company, said it was a very sound undertaking, but it had been hampered of late years by reason of the increase in the cost of material. It was formed in 1908 for the purpose of carrying on in Cordoba and the Argentine an electric light and power undertaking, and the running of tramways. It acquired the undertaking by purchasing the shares of two companies, one registered in the United States and the other in the Argentine. The present authorised share capital was £1,000,000 in £1 shares. The company had carried on business very successfully. It had to spend its cash on its undertaking, and there was a sum of £106,205 standing to undivided profits account. It had performed all its obligations, and it paid its preference dividend down to September 30th, 1915. Since then, although making large profits, the company had had to use its cash in other directions, and there was an arrear of six years on the preference shares amounting to £75,000. In order to put the company on a sound financial basis this scheme of arrangement had been entered into. Mr. Jenkins said the scheme had been approved practically unanimously by promissory note holders, preference and ordinary shareholders, and debenture holders.

Melbourne Electric Supply Co., Ltd.

The directors' report for the year ended August 31st last, is the first since the headquarters of the company was moved from London to Melbourne to evade double taxation. The gross profit amounted to £235,160, as compared with £221,388 in 1920. £22,987 was written off on account of stamp duty on capital and the underwriting of a preference issue; the cost of transferring to Melbourne, including compensation to directors, absorbed £15,220; equipment at and alterations to the Melbourne office, cost £10,040; £30,000 was transferred to the general reserve; leaving a balance of £96,750. Interim dividends absorbed £42,563. The balance of £54,187 was allotted as follows:—Dividend on 8 per cent. cumulative preference shares for the half-year, £18,462; 5 per cent. on ordinary consolidated stock (making 10 per cent. free of British income tax for the year), £31,690; and dividend at the rate of 10 per cent. per annum on ordinary shares, £1,737. The balance of £2,297, and £54,741 brought forward, making a total of £57,038, were carried forward.

At the annual meeting held in Melbourne in December last, the Chairman, Mr. Agar Wynne, referred to the change of headquarters, stating that this had been necessitated by the policy of the British Government of enforcing the payment of British income tax upon Australian shareholders in companies with British registration. The change was approved in July, 1920, and as from the following month the business of the company had been carried on in Melbourne. The London directorate retired and control was vested in the existing Australian directorate. The saving in taxes thus effected was considerable, and would be greater as the company's business extended. The London office was still necessary both on account of the many European share and debenture holders, and owing to the large machinery purchases which would be necessary to enable the company to cope with the growing demand for electricity. The directors had, therefore, appointed three attorneys in England:—Mr. B. Brookman, a former director; Sir George Shead, a prominent shareholder; and Mr. W. E. Lane, who had been secretary of the company since its commencement.

Turning to the company's operations, the chairman said that, unfortunately, the supply area was solely suburban, and, therefore, its load was not so large and concentrated as loads in central business and pleasure areas; development had been difficult on this account, and for twelve years the ordinary shareholders had received no dividend. The year under review had also been a difficult one in consequence of war and post-war conditions. A shortage of plant was experienced and the delivery of additional machinery had been delayed. The maintenance of continuity of supply had consequently become a heavy burden on the operating staff. The increase in operating costs, combined with the restrictions of supply necessitated by strikes, had retarded the growth of gross profit, as compared with previous years. The shortage of power had now been made up to a certain extent by the installation of a 5,000-kW frequency changer set which enabled a supply to be taken from the Government railway power house at Newport. A second frequency changer was to be installed shortly. In order to meet further future requirements, the company had arranged to take a total supply of 15,000 kW from the Government, and for this purpose a third frequency changer would be installed. The change-over of the Geelong system from d.c. to three-phase a.c., was nearing

completion; the d.c. plant had been shut down and the a.c. generators were supplying the district. This alteration would make for considerable economy in operating costs; Geelong was an important industrial centre, and many applications for large supplies had been received.

The company's Geelong tramways were to be extended in several districts, and it was hoped that prices of material and construction would have reverted to more reasonable dimensions by the time these extensions were commenced. During the year two further issues of capital had been made, viz., £150,000, 8 per cent., first cumulative preference shares, and an issue of consolidated stock and ordinary shares, the latter convertible to ordinary stock, when paid in full, of £204,235. A further loan was to be raised in the United States to repay the present loan raised during the war by the issue of 256,850, 6 per cent. gold bonds. The expenditure on plant and mains during the year was £264,010 in Melbourne, and £126,332 in Geelong, making the total expenditure on the undertakings, less the amount written off for obsolete plant, £1,949,147 and £378,783 respectively.

Dublin United (Electric) Tramways Company.

The Right Hon. L. Waldron, P.C., chairman, presiding at the annual meeting, recalled that they were heavily handicapped by the military curfew restrictions in the early part of 1921, and by the general state of disturbance and unrest that then prevailed. In the circumstances the interim dividend of 3 per cent. at the end of June was all that could be expected, and it was paid with some hesitation. In the subsequent months they recovered their position to some extent. Passenger receipts had increased by £74,063 over the previous year, and in the parcels department there was an increase of over £1,700, and a like sum for carriage of minerals. They had also been helped on the expenditure side by a decrease in working of £7,507. In the car body shop there was a decrease of £7,561 in expenses. Against the decrease in working they had in the trucks department an increase of £9,672 for 32 new trucks, and in the electrical equipments there was an increase of £16,558. Permanent-way maintenance showed an increase of £7,879, and renewals had involved an outlay of £14,784. The increase on steam plant was £2,845; on cables, £5,308; and on general plant, £2,523. He next referred to the increase in staff wages, £5,069, making £119,245 since the war. Rates had further increased by £3,500; and income tax by £12,000. There was an increase in passengers carried, as compared with 1920, of 700,000.

The report was seconded by Mr. J. Mooney, J.P., and passed, Mr. J. J. Maquire saying the shareholders were well satisfied.

On the motion of Mr. Hewat, seconded by Dr. Lombard Murphy, a dividend was declared at the rate of 6 per cent. per annum, less tax, on the preference stock for the half year ending in December last, and a final dividend was declared on the ordinary stock for the same period at the rate of 7 per cent., less tax, making 5 per cent. for the year. Mr. Joseph Mooney, J.P., was re-elected to the directorate.

Railway Companies.

The London, Brighton & South Coast Railway Co. reports a net income of £1,344,256, as compared with £1,535,449 in the previous period; both receipts and expenditure showed decreases. The electric train-mileage increased from 1,182,252 to 1,194,040, while the steam train-mileage fell from 7,837,313 to 7,659,449. Included in the capital expenditure was an item of £44,652 for extensions of electrification and consequent structural alterations. The report states that the Balham-West Croydon extension is approaching completion.

The net income of the Lancashire & Yorkshire Railway for 1921 was £2,136,137, as compared with £2,656,706 in 1920. There was a falling-off in both steam and electric train-mileage.

The South-Eastern & Chatham Railway Companies' Managing Committee reports a balance of revenue of £1,861,280, which will be divided as follows:—South-Eastern Railway, £1,098,155; London, Chatham & Dover Railway, £763,125. This is a slight increase on the previous year's result. The Committee mentions that application has been made to the Advisory Committee under the Trade Facilities Act, 1921, for financial assistance in carrying out projected electrification schemes.

The Siemens-Schuckert Group

The accounts have been issued of two of the companies in the Siemens group. When this group became associated in 1920 with the Rhine-Elbe Union the financial year of the former was changed from July to September 30th so as to harmonise with that of the latter, the result being that they electrical companies had a provisional financial year composed of two months, which ended on September 30th, 1920. Bearing this in mind, it is inappropriate to compare the working results in the year ended with September 30th, 1921, with those for the two months forming the preceding year; they are therefore compared with those for the twelve months which terminated on July 30th, 1920.

The Siemens & Halske Company reports gross profits and balance forward amounting to 55,578,000 marks for 1921-22, as contrasted with 26,844,000 marks in 1920-21. After meeting general expenses, interest on loans, and allotting 6,000,000 marks to benevolent purposes, the accounts show net profits of 37,008,000 marks as against 16,435,000 marks. It is proposed to pay a dividend at the rate of 20 per cent. on ordinary share capital of 130,000,000 marks (14 per cent. in 1920-21), to place 2,680,000 marks to the legal reserve fund, which thus becomes increased to 10 per cent. of the share capital, and allocate 5,000,000 marks to the special reserve fund, which rises to 28,000,000 marks.

The accounts of the Siemens-Schuckert works show gross profits of 62,667,000 marks, including the balance forward. Having made provision for general expenses, depreciation, &c., and appropriated 12,000,000 marks for the benevolent foundation, the net profits are returned at 22,502,000 marks, as compared with 12,769,000 marks in the twelve months ended with July 31st, 1920. The dividend is at the rate of 16 per cent., as against 10 per cent. The sum of 5,000,000 marks has been placed to the reserve fund and the carried forward amounts to 2,102,000 marks. A reserve fund of 94,000,000 marks has been provided for "replacement of plant" in course of execution. A similar fund has been created by the Siemens and Halske Co., although the amount is not stated.

New Issues.—*Yorkshire Electric Power.*—Underwriting in respect of a forthcoming issue of £558,360 6 per cent. cumulative preference shares of £5 each fully-paid of the Yorkshire Electric Power Co., at the price of £4 per share has been arranged.

The public issue, which is subject to confirmation at an extraordinary meeting of shareholders called for Tuesday, the 21st instant, is expected next week.

City of Buenos Ayres Tramways Co., Ltd.—The annuity payable by Anglo-Argentine Tramways Co., Ltd., has been received, and the net revenue for year amounted to £71,339. It is proposed to pay a final dividend of 1s. 3d. per share (making 5 per cent. per annum, less tax) for the year ended December, 1921, £2,000 being transferred to general amortisation fund, and £7,339 carried forward.

South Metropolitan Electric Light and Power Co., Ltd.—The transfer books and register of members will be closed from February 18th to 28th (both days inclusive) for the preparation of warrants for dividends payable on and after the 28th instant, in respect of the 7 per cent. cumulative first preference shares, 6 per cent. cumulative second preference shares, and ordinary shares.

North London Railway.—A final dividend of 3¾ per cent. is being paid on the ordinary shares for the half year ended December 31st, 1921, making a total of 6 per cent. for the year. The holders of the preferential consolidated stock are entitled to an additional dividend of 10s. per cent., making 5 per cent. for the year. £10,000 is placed to reserve and £14,700 carried forward, being practically the same as in the previous year.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—After paying 6 per cent., less tax, on the cum. preference shares, £19,126 is placed to renewals, depreciation and reserve, and £4,230 is carried forward.

Bournemouth and Poole Electricity Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, for the half-year, making 6 per cent. for the year.

Liverpool Overhead Railway Co.—Dividend at the rate of 5 per cent. per annum, less tax, for the year ended December 31st last, on the preference shares.

County of London Electric Supply Co., Ltd.—Final dividend at the rate of 11 per cent. on ordinary shares, making 8 per cent. for the year. To reserve £180,000. Carry forward £21,000.

Central Electric Supply Co., Ltd.—During 1921 energy was supplied to the Westminster, St. James', Pall Mall, and Chelsea Companies to an amount of 39,857,600 units.

W. T. Henley's Telegraph Works Co., Ltd.—The directors recommend a final dividend on the ordinary shares of 2s. per share, less income tax, making, with the interim dividend of 1s. per share already paid, 3s. per share for the year.

Cambridge Electric Supply Co., Ltd.—There was a total profit of £13,064 for the year 1921, plus £2,112 brought forward. Debenture and other interest requires £2,379; £5,000 is put to depreciation fund; a dividend of 5 per cent. for the year is to be paid and £2,841 carried forward.

German Company.—The Rheinische Elektrizitats Gesellschaft, of Mannheim, has just invited subscriptions for 18,000 new ordinary shares of 1,000 marks each, issued at a premium of 160 per cent.

Mather & Platt, Ltd.—Further dividend of 7 per cent., making 10 per cent. for the year.

Frederick Braby & Co.—Interim dividend of 5 per cent., less tax, on ordinary shares.

STOCKS AND SHARES.

Tuesday Evening.

Expectation of an immediate fall in the Bank Rate continues to operate as the principal factor in the Stock Exchange markets, where disturbances in India and Ireland affect only such securities as those which are intimately concerned. The extraordinary way in which new issues are being snapped up by the public may be regarded as another feature of the day. For any promising attractive investment, there is no lack whatever of public money. In addition, the publication of the Geddes report serves to furnish the hope of a possible lightening of taxation in the (more or less) near future. At the same time, evidences of trade revival are not sufficiently pronounced to render probable the withdrawal of any substantial amounts of money from purely investment stocks into trade directions. Therefore, anticipation looks for capital to continue seeking Stock Exchange channels for its employment, until commerce takes a more definite turn for the better than is apparent yet. Big contracts are about, but in some cases the execution of them has been postponed. The railway dividends make a good showing, and prices in this market are decidedly better than they were at the beginning of the year.

The Underground Electric Railways Company is one of the few to disappoint its proprietors with its dividend. On the Income Bonds 4 per cent. free of tax is declared, making this rate for the full year. Most people have been expecting five and some had thought the full 6 per cent. would be paid. The principal surprise came from the District Company, which declared a dividend of one per cent. for the whole of 1921, the first paid since 1882. Few had looked for any distribution until the first six months of the current year had run their course, and the price of the stock rose to 24½ before it went back a point. Metropolitan Consolidated advanced to 31½, the report being regarded as exceedingly good. The company as already mentioned, is paying a dividend which makes 2¼ per cent. for the year. The Metropolitan Railway received £206,000 from the Government as the first instalment of the amount to which it is entitled under the Railways Act of 1921. This has been put to reserve, instead of being utilised in the distribution of dividend, whereas steam companies, in most cases, have taken part of their Government award to augment their dividend announcements. The Central London dividend of 4 per cent. for 1921 goes against 2¼ per cent. for 1920, and improvements are shown by the London Electric Railway, City & South London, and London General Omnibus Companies. Underground Incomes receded 3 to 72½, the £10 shares remaining at 1⅞ and the 1s. shares at 5s. East London third debentures moved back a couple of points to 16½, the ordinary drooped to 3½, but the other stocks of the company retain their recent rises.

Declaration of a dividend, making 4 per cent. for the year, by the London Electric Supply Corporation, shows an increase of 1½ per cent. over last year. It caused the price to improve 3s. 9d. to 1 5/16, and the preference rose 5s. to 3½. The St. James's and the Westminster Companies declare the same dividends as those of last year, and the prices on the week are unchanged. Metropolitans are 4⅛, which is ¼ down, but a rise of ¼ occurred in Chelseas to 3⅞. Several new issues are known to be on the point of making their bow. The Scottish Power Co's. 8 per cent. preference shares will probably be introduced to the market this week on the basis of 19s. 6d. to 20s. for the £1 shares, fully-paid. The Yorkshire Power Co. is about to make an offer of about 110,000 £5 preference shares, carrying interest at 6 per cent., at £4 per share. It is, of course, impossible for most companies to offer preference shares at a discount, but this being a Parliamentary undertaking, the prohibition does not apply. The North Metropolitan Electric Co's. 8 per cent. preference stock at par will be advertised this week.

Meanwhile existing stocks and shares remain very firm. The North Metropolitan Electric debenture is 103½; Newcastle-upon-Tyne second debenture at 88½ is one higher. Shropshire and Midland Counties 7½ per cent. debentures are both hard at 102½. The Fife Tramways debenture stands at 5 premium, Llanelly fully-paid scrip at 98½. Nor is there any cessation in demand for these stocks, in spite of the newcomers. Each security appears to have its own circle of supporters who regularly put money into the stocks and shares week by week.

General Electrics have been a little over £1, but reverted to 20s. Several of the railway companies announce their attention of extending electrification of their systems as soon as they are able to do so. The South-Eastern quickly followed upon the heels of the Brighton Railway in a statement to the effect that only by electrification can the company hope to deal with its present-day traffics. Something of a feature in the industrial list is a rise of half-a-crown in India-Rubber shares, which took the price to 13s. 9d. Babcock & Wilcox are 1/16 lower at 2½.

The cable group is steady, though movements are unimportant. Globe preference hardened to 10, Anglo-American preferred to 91½, Great Northerns to 27. On the other hand, Marconis drooped to 1 11/16. Radio Common at 17s. 9d. and the preferred at 12s. 3d. are both rather better than they were a few days ago, though, of course, these prices are below the best recently reached. The motive for the market movements continues to come almost entirely from America.

Mexican Utilities have halted in their rise, disappointment being felt with the answer of Mr. Harmsworth in the House of Commons on Monday night replying to a question as to why recognition had not been granted by this country to Mexico, and trade, therefore, put upon a better foundation. The official answer was scarcely ingenuous; it conveyed the impression that the British Government are not doing as much as they might in order to foster trade between this country and Mexico, although the United States is straining every nerve, and successfully, to capture the chief commercial avenues leading to and from that country. British Columbia stocks are quiet; Anglo-Argentines hold their prices.

Of rubber shares there is nothing fresh to say beyond the usual observation that the market is dormant, owing to the flatness of the raw produce. More heed is being paid, perhaps, to the austere doctrine that it may be to the advantage of the industry, after all, if the weakest companies are permitted to go to the financial wall. Iron and steel shares show little animation, and nothing of fresh consequence has transpired in the armament share list. The published approval of the Stock Exchange Committee in regard to a return to periodical settlements and contango-business is received with general favour and a little opposition. Nothing definite can be done until the Treasury releases the Stock Exchange from the Regulations which remain a legacy from the Governmental control of the stock markets since January, 1915.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Feb. 14, 1922.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	6⅝	—	£8 17 10
Charing Cross Ordinary	7	8	4⅝	—	8 4 2
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	4	6	3¾	+ ⅛	7 14 10
City of London	13	14	1⅝	—	9 6 8
do. do. 6 per cent. Pref.	6	6	19/-	—	6 6 4
County of London	8	8	9½	—	8 4 2
do. do. 5 per cent. Pref.	6	6	8½	—	7 2 10
Kensington Ordinary	7	9	5½	—	8 3 8
London Electric	2½	2½	1 15/16	+ 1/16	8 7 6
do. do. 6 per cent. Pref.	6	6	3¾	+ ¼	8 11 6
Metropolitan	6	7	4⅛	— ⅛	8 0 0
do. 4½ per cent. Pref.	4½	4½	3 3/16	—	7 1 2
St. James' and Pall Mall	12	12	7	—	8 11 6
South London	6	7	2⅝	—	10 9 0
South Metropolitan Pref.	7	7	1 7/16	—	6 11 8
Westminster Ordinary	10	10	6½	—	7 13 10
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	91½	+ ½	6 11 2
do. Def.	1½	1½	19	—	9 3 6
Chile Telephone	6	6	5½	—	5 14 3
Cuba Sub. Ord.	7	7	7½	—	9 6 8
Eastern Extension	10	10	17	—	5 17 8
Eastern Tel. Ord.	10	10	170½	—	5 17 4
Globe Tel. and T. Ord.	10	10	17	—	5 17 8
do. do. Pref.	6	6	10	+ ½	6 0 0
Great Northern Tel.	22	24	27	+ ½	8 17 10
Indo-European	10	10	52	—	7 16 3
Marconi	25	15	1 11/16	— 1/16	8 17 10
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	6 1/16	—	*6 6 9
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	17½	—	*5 16 0
Home Rails.					
Central London Ord. Assented	4	4	57	—	7 0 4
Metropolitan	1½	1½	31½	+1	7 2 10
do. District	Nil	Nil	23½	— ½	4 5 1
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. do. Income	4	2	72½	—3	*5 10 4
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	2 1/16	—	9 15 6
do. do. 2nd Pref.	Nil	5½	3½	—	8 19 6
do. do. 5 per cent. Deb.	5	5	71½	—	6 19 10
Brazil Tractions	Nil	Nil	34	+1	Nil
British Columbia Elec. Rly. Pfce.	5	5	61½	—	8 2 8
do. do. Preferred	5	93/-	68½	—	*7 18 0
do. do. Deferred	3	134/-	60½	+1	*10 8 4
do. do. Deb.	4½	4½	63½	—	6 16 0
Mexico Trams. 5 per cent. Bonds	Nil	Nil	69½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	28½	—	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	36½	—	Nil
do. 1st Bonds	Nil	5	62½	—	8 0 0
Manufacturing Companies.					
Babcock & Wilcox	15	15	2½	— 1/16	6 8 0
British Aluminium Ord.	10	10	16/6	—	—
British Insulated Ord.	15	15	1 1/16	—	8 17 10
Callenders	15	15	1½	— 1/16	10 0 0
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Crompton Ord.	10	10	18/9	—	14 11 0
Edison-Swan	10	—	4/6	—	—
do. do. 5 per cent. Deb.	5	5	62	—	8 1 4
Electric Construction	10	10	18/9	—	10 13 4
English Electric	8	8	9/6	—	16 17 6
do. Pref.	6	6	12/6	—	9 12 0
Gen. Elec. Pref.	6½	6½	18/9	—	6 18 8
do. Ord.	10	10	20/-	+6d.	10 0 0
Henley	15	15	32/-	+9d.	9 7 6
do. 4½ Pref.	4½	4½	8½	—	8 0 0
India-Rubber	10	—	3/4	+ ⅛	—
Met.-Vickers Pref.	8	8	1⅝	—	8 10 8
Siemens Ord.	10	10	23/-	—	*8 13 10
Telegraph Con.	20	20	23	—	*5 4 2

* Dividends paid free of Income Tax.

THE PHYSICAL SOCIETY OF LONDON.

Twelfth Annual Exhibition

(*Concluded from page* 210.)

Messrs. H. Tinsley & Co., in addition to many interesting instruments, had on view the new Shotter electrolytic flowmeter that, besides indicating at any given instant the quantity of water flowing, automatically records on a chart the amount of water which has passed at any time during the 24 hours.

The method of connecting up the instrument is illustrated in fig. 27, A being the ratiometer, B the battery, C the control coil, D the deflection coil, E the zero line, and W the weir. We understand that one of the instruments is to be installed at the Brimsdown power station of the North Metropolitan Electric Power Supply Co., and from test figures supplied to us it appears that the new meter is extraordinarily accurate.

The purpose of the apparatus is to measure the depth of solutions, particularly water, and thus is specially adaptable for the measurement of the height or flow of water over weirs, or notches, and it has the advantage that the depth or flow may be indicated or recorded at considerable distances. The action of the apparatus depends upon the electrical conductivity of solutions, and in use the solution, of which the depth or flow is to be measured, is employed as the electrolyte. Two electrolytic paths are provided, one in which

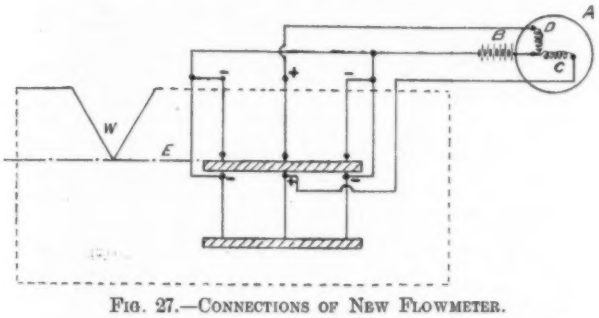

Fig. 27.—Connections of New Flowmeter.

the dimensions vary with the depth or flow of the solution, and the other in which the dimensions are constant and independent of the depth or flow of the solution. The above conditions are obtained by submerging one path below the apex of the notch or weir and placing the other path in such a position that when no solution is passing over the notch no current is passing in the variable path, *i.e.*, the zero of the variable path is placed on the same level as the apex of the notch. By measuring the ratio between the two currents that flow in the two electrolytic paths, *i.e.* (C in variable path/C in standard path) from a common source of e.m.f. the result is a function of the depth or flow of the liquid, and is independent of all variables, such as applied e.m.f., back e.m.f., specific conductivity of the solution or water, temperature, &c.

The above, of course, presupposes that both electrolytic circuits are identical, and to ensure this both paths are placed in the notch tank so that the solution (or water) is continually flowing through the paths. For measuring the ratio of the two currents a ratiometer or ohmmeter is used, which automatically gives the ratio required. To enable the ratiometer scale law to be a straight-line function of the flow the "variable path" is so shaped that the area exposed is proportional to the flow at all heights, *i.e.*, for instance, when the flow varies as $H^{2.5}$, then the width of the variable path would vary as $H^{1.5}$. In practice the electrolytic paths are formed in some suitable insulating material, such, for instance, as porcelain or lapilac, &c.; the particular material chosen must, however, be non-hygroscopic,, have high insulating properties, and as cases arise when the temperature of the water may reach 200 deg. F., must not warp at this temperature. The anodes are of platinum made up from wire of about 45 s.w.g., so designed that the minimum amount of platinum is used; the cathodes are generally constructed of nickel or graphite. The whole of this apparatus is constructed so as to allow easy access to all parts for cleaning purposes; the cathodes particularly are so arranged that they can be readily taken out to enable any deposit thereon to be removed.

A complete instrument for working in conjunction with the electrolytic paths comprises an indicator, a graphic recorder, and an integrator. The component parts of the instrument consist of a ratiometer or ohmmeter, a master clock fitted with an "instantaneous" contact attached to the second wheel, a chart drum driven by a ratchet and pawl, a locking bar for depressing the needle of the ratiometer on to the chart, the indication on the latter being made by means of a steel point fixed to the needle and a carbon ribbon. A traversing arm operated by electro-magnetic means in a plane parallel to the needle has attached to it one portion of an electro-magnetic clutch, the other part of the clutch being attached to the usual train of indicating wheels. At the end of the traversing arm is fixed a pair of contacts, which engage with the needle, and which open circuit when driven against the fixed needle.

The operation of the mechanism is briefly as follows: The master clock completes a circuit every ten seconds, the circuit comprising the clutch coil, the chart drum-operating coil and the locking-bar coil, consequently the needle is locked in the position which it has taken up due to the flow; secondly, the train of indicating wheels is connected by means of the clutch to the traversing arm and, thirdly, the chart drum is moved forward a definite amount. At the end of the travel of the armature operating the locking arm is attached a contact which puts into circuit the traversing arm coil; this arm, which is damped by means of an oil dashpot, slowly moves from zero in the direction of the locked needle, carrying with it the integrating mechanism. As soon as the contact on the traversing arm is opened by coming into contact with the needle the three-coil circuit mentioned above is opened, consequently releasing the clutch, the locking bar, and the drum-driving armature; the locking-bar, in turn, open-circuiting the traversing arm coil. A contact is also fitted to the clutch or locking bar in parallel with the instantaneous contact on the clock which keeps the circuits maintained until the traversing arm contacts are opened. The traversing arm now returns to its zero position, but of course does not carry with it the integrating mechanism.

The connections between the instrument and what may be termed the transmitter generally consist of either two-core, lead-covered, or three-core cable. In the first case the lead is connected to the cathodes and the other two cores are connected to each of the anodes. In cases where the instrument is required to indicate weight instead of volume a compensating device is attached, which enables this to be done with an accuracy, it is claimed, of a quarter of one per cent. from 50 to 100 deg. F. When the instrument is used for measuring condensate from steam engines a second scale can be added, which indicates the specific conductivity of the water, a switch being fixed to the instrument which makes a suitable change in the connections of the instrument for this purpose. This is an extremely useful addition, as not only does it allow a check to be kept on the tightness of the condenser, but enables the engineer to get an approximate idea of what he is really measuring.

THE FARADAY SOCIETY.

The Structure of some Gaseous Molecules.

Recent work on atomic structure has tended to overshadow the subject of how the atoms are arranged within the molecule. Some excellent work in this direction has none the less been undertaken and a good example of it is Prof. A. O. Rankine's researches on the structure of gaseous molecules containing hydrogen, the latest results of which he expounded at the December meeting of the Faraday Society.

Prof. Rankine's method is based on viscosity measurements, of which a good deal of reliable data has lately become available. From the ordinary kinetic theory of gases a value of the mean collision area of a molecule can be deduced, but the result has hitherto yielded figures which vary with the temperature. This was because viscosity was erroneously assumed to be a function of the square of the temperature. The true relation is given in a formula by S. Chapman, and on this basis and that of recent viscosity measurements Prof. Rankine has calculated the mean collision area of the following eight gases; HCl, HBr, HI, H_2S, NH_3, PH_3, AsH_3, CH_4. It must be made clear that mean collision area means the average cross section of a molecule taken as a mean at all orientations. For purposes of comparison the mean collision areas of the molecules neon, argon, krypton and xenon have also been calculated, seeing that these molecules on account of their inertness or absence of valency, and consisting, as they do, of a single atom, can reasonably be regarded as spherical.

The areas (by which term will always be meant mean collision areas) of the above-mentioned twelve gaseous molecules are studied from the point of view of Table I, p. 246, which is, of course, based upon a section of the periodic table of elements.

Now, seeing that, according to the current conception of the atom, elements contiguous in the periodic table differ only in the matter of one nuclear positive charge and one electron, the atoms in any row of Table I, such as A, Cl, S, P, and Si will change very little in size. In this particular instance the atomic numbers vary only from 18 to 14. This approximation in size of successive atoms is confirmed by the X-ray analysis of crystals. The combination of hydrogen with chlorine to form HCl is brought about—in the Lewis-Langmuir view—by the entry of the single hydrogen electron, the hydrogen nucleus remaining attached externally to the system. The system will, therefore, be equivalent in size to an argon atom with one hydrogen nucleus attached to it. Similarly, H_2S will be equivalent to an argon grouping of electrons with two hydrogen excres-

cences, and PH_3 to one with three hydrogen excrescences. This is illustrated in the diagram (fig. 1).

It is to be expected that the mean collision areas of the molecures A, HCl, H_2S, and PH_3, and similarly of the molecules of corresponding compounds in other groups, will increase as we pass along the series, and this is confirmed by

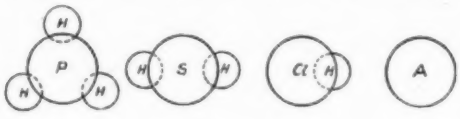

Fig. 1.

actual measurements of these areas deduced from the viscosity determinations already referred to. The actual figures are indicated by the curves in fig. 2.

From these figures for mean collision areas, and assuming the structure illustrated in fig. 1, the actual position of the hydrogen protuberances can be calculated, and it transpires that the protuberances get notably larger as their number increases. It is reasonable to ascribe this to the mutual repulsion excited by the hydrogen nuclei in one another, and

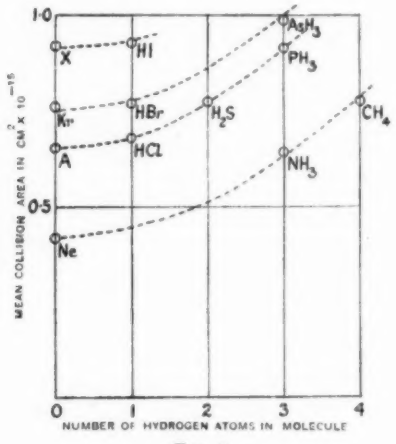

Fig. 2.

in this view one would expect a point to be reached where the further addition of hydrogen atoms became impossible owing to the instability of the system, and indeed compounds like BH_3 and AlH_3 have no existence.

Interesting confirmation of Prof. Rankine's conception is given by measurements of the relative dimensions of CH_4 and Kr. According to fig. 2 the mean collision areas of these substances should be almost identical, and the molecule of methane and the atom of krypton do actually prove to be

Table I.

CH_4	NH_3	(H_2O)	(HF)	Ne
(SiH_4)	PH_3	H_2S	HCl	A
	AsH_3	(H_2Se)	HBr	Kr
	(SbH_3)	(H_2Te)	HI	X

of the same size within the limits of experimental error. Now, if we pass to the corresponding atoms in the periodic system with next higher atomic numbers we arrive at NH_4 and rubidium, and the equality of dimensions of these substances is again confirmed by X-ray measurements of crystals containing them. Thus the results of estimates of molecular dimensions derived from viscosity determinations and crystal measurements mutually confirm one another.

Competition for the Design of a Moving Platform for Paris.—Twenty competitors, including one Englishman and one Belgian, have already signified their intention of taking part in this competition, and have asked for further information. Competitors will have to furnish a detailed description of the mechanical system proposed; of the methods of working; dimensions of the different parts of the moving system and of the platforms; details of the driving power; the minimum curvature and the maximum gradient; and finally estimate the cost of construction, installation, &c.—*Reuter's Trade Service* (Paris).

THE ELECTRICAL WHOLESALERS' FEDERATION.

On February 2nd about eighty members of the E.W.F., with guests from other associations of the electrical industry, met at dinner at the Trocadero Restaurant. Mr. H. Boden-How (President of the E.W.F.) presided, and the principal guests were Messrs. D. N. Dunlop (B.E.A.M.A.), J. Y. Fletcher (E.L.M.A.), J. Macgregor (C.M.A.), L. G. Tate (N.E.C.T.A.), and J. W. Beauchamp (E.D.A.). After an excellent dinner, and the toast of the King, Mr. Albrecht proposed the toast of "Kindred Associations." He said that the first thing the E.W.F. had had to do upon its formation was to settle its own affairs and set its house in order, but he supposed that this occurred in the case of every new association. Their next aim was to get into closer touch with kindred associations, as it appeared to them that co-operation was their *métier*. At the Federation's last function only three other associations had been represented. This year there were two more—"Beama" and "Eda." He asked Mr. Dunlop to do something to bring their respective associations into closer touch. The E.D.A., he said, was a younger body, but undoubtedly a power for good. It was close to the Federation's heart, and the Federation hoped to demonstrate its devotion in a practical way in the near future. There was always a seat at the Federation's functions for the N.E.C.T.A. The E.W.F. had also formed a close affinity with the E.L.M.A.; it was entitled to support in its efforts to exercise a legitimate control of its particular part of the industry. His personal association with the C.M.A. gave him a bias towards it; all the Association's dealings were conducted with a rare integrity. The fact that numbers of trade associations were cropping up all over the country led him to believe that the industry as a whole was not functioning properly. A spirit of unrest was abroad. The contractors said that they were not being handled properly; the manufacturers made the same complaint. Mr. Albrecht thought the trouble was due to the fact that the industry was still young and the manufacturers had peculiar circumstances to deal with. The selling side of the industry seemed to have broken down, and manufacturers had, therefore, built up their own selling organisations. The contractors must build up a better organisation and the manufacturers would gladly hand over their products to it. Many contractors realised that they had been engineers first and salesmen second.

Mr. D. N. Dunlop, in reply, said that after settling its domestic problems the B.E.A.M.A.'s first task was to see that the industry made sufficient profits to attract investors besides providing proper remuneration for engineers, and leaving a balance for research. There were numerous difficulties, but he considered that the B.E.A.M.A. had succeeded in putting the industry into a healthy state. The organisation did not aim at bringing all manufacturers in direct line; initiative and invention were encouraged. Mr. Dunlop touched upon the Safeguarding of Industries Act, saying that he had endeavoured to persuade manufacturers to take advantage of it—but they generally seemed suspicious of it. However, the industry could not rely upon Government aid—co-operation was necessary. He (Mr. Dunlop) was carried away when he considered what the industry could do for this country. With the co-operation of manufacturers, contractors, factors, and the Press, all difficulties would be overcome and all problems solved, until the British electrical industry was the finest in the world.

Mr. J. Y. Fletcher, also responding, said that the manufacturer, factor, contractor, and user were all cogs in the machinery of the industry, and harmony should reign amongst them. He referred with satisfaction to the recent decision of the House of Lords regarding the gasfilled-lamp patents. This had made it possible for the E.L.M.A. to arrange satisfactory long-period agreements, and it now had a certain tenure of business in the markets of the British Empire. The E.L.M.A. was wedded for all time to the factor policy, and Mr. Fletcher promised this year new agreements, which would benefit all concerned. He wished that the policy of Mr. F. Gill, who used to take dissatisfied subscribers to view the working of a telephone exchange, could be followed in the lamp industry. Factors and users would gain a great deal of information from a visit to a lamp factory.

Mr. J. Macgregor, replying on behalf of the C.M.A., also urged the need for unity, not only between sections, but between employers, and spoke of the success achieved by the Joint Industrial Council of the industry. There were still many differences, and the only way to compose them was by means of conferences.

Mr. L. G. Tate, for the N.E.C.T.A., thanked the *Electrical Times* for publishing correspondence which had led to a conference of the industry being called to discuss mutual questions; he had hopes of good results from this meeting. The N.E.C.T.A. was considering the opening of showrooms in various parts of the United Kingdom, which would benefit all connected with the industry.

Mr. J. W. Beauchamp also briefly replied, saying that the E.W.F. had an important part to play. He looked upon it as a reservoir into which manufacturers should pour a steady stream of appliances, which should supply the appliances to users at the irregular rate which fluctuations in

demand dictated. Mr. Beauchamp said that the British were not born co-operators, in fact it was their individualism which had led to their success. The ideal state was a groundwork of individualism with a superstructure of co-operation.

Mr. Smith (Drake & Gorham) then presented the retiring hon. general secretary (Mr. A. G. Beaver) with a service of silver plate and a cheque, with a speech of appreciation.

Mr. Beaver thanked his associates, and expressed his satisfaction at securing their esteem and goodwill. His successor (Mr. Cooper) had a difficult task to confront, but he wished him success.

Mr. J. W. Dodds, in a brief speech, eulogised the President of the E.W.F. and proposed his health, and Mr. Boden-How, in reply, asked the other electrical associations to form a closer relationship with the E.W.F.

The final toast, that of "The Press," was proposed by Mr. G. Donovan, and responded to by Mr. R. W. Hughman. A number of concert items were contributed by Messrs. Clay Thomas and George Buck, Miss Dorothy George and Miss Hilda Bertram. Mr. Frederick Arthur was accompanist.

SINGLE AND THREE-PHASE A.C. COMMUTATOR MOTORS WITH SERIES AND SHUNT CHARACTERISTICS.

Discussion at Liverpool.

Dr. S. P. Smith submitted his paper on the above subject (an abstract of which appeared in our issue of January 13th) to the Liverpool Sub-Centre of the North-Western Centre of the Institution of Electrical Engineers, on December 12th, 1921.

Mr. F. J. Teago confined his remarks to some tests made in the laboratories of the Department of Electrical Engineering, Liverpool University, on a motor exactly similar to that shown by Dr. Smith in fig. 4c of his paper. Simple, efficient, and reliable speed control was a necessary adjunct to any motor, if it was to find wide application. He showed curves relating to the b.h.p. power factor, and efficiency of the motor in terms of rotor speed, from which it would be seen that the b.h.p. was proportional to the speed, and that over a range of 500-1,500 r.p.m. the power factor varied from 0.6 to 0.96 and the efficiency varied from 75 to 80 per cent.

There was no doubt, then, that the efficiency of speed control was good. The reliability could be judged from fig. 4c, and the note "(ii). With shunt characteristics (c)" in Dr. Smith's paper. Provided that the commutator and brush gear were amply proportioned, and they certainly were in the motor under consideration, no trouble should arise unless the output h.p. per pole was excessive.

The simplicity of the speed control could be imagined from the statement that, provided the brushes were set to the position marked "start" (about 300 r.p.m.) the motor, under full-load torque, could be safely thrown straight on to the three-phase supply lines and the speed brought to the required value by merely turning the handle shown in fig. 4c. Under those conditions the motor took rather more than full-load current. Thus it must be conceded that the motor was a very clever answer to the question of speed control.

Mr J .S. Peck explained that the development of a sucessful a.c. commutator motor had long been the goal of the electrical designer, for it held tremendous possibilities with regard to speed and power factor control. There was no great difficulty in manufacturing motors of that type for low horse-powers, but the difficulties increased very rapidly with the size, and it spoke well for the courage and engineering ability of certain manufacturers that they had been able to produce successful motors of fairly large size, but the speaker doubted if any firm had made a financial success of that type of machine, especially in connection with those of larger outputs. A successful commercial motor must be able to work on a 50-period circuit, and to build a commutator motor for 50 periods, was a much more difficult problem than building one for 16⅔ or even for 25 periods; 16⅔ was the frequency adopted on the Continent for single-phase railway motors.

Mr. D. I. Dawbarn thought one of the most interesting points in Dr. Smith's fig. 4c, was the variation in the position and diameter of the circle diagram for the motor working against full-load torque with varying speed. The character of the circles was shown by the speaker, the variation in the position being due to phase changes in the resultant e.m.f. in the current found by the brushes and the stator windings, whilst the variation in diameter was partly due to the differing magnitude of the resultant e.m.f. and partly due to changes in the coefficients of self and mutual induction as the speed changed.

The a.c. commutator machine had a certain very limited field as a phase advancer, or power factor corrector on large induction motors. It might have a considerably larger field as a means of controlling the speed of large induction motors, but the complications involved in that system of speed control, were such as to make most practical men hesitate to adopt it. As a simple variable-speed motor there was not a large field for the machine. Its advantage was that it might be coupled direct to the a.c. mains without converting plant, and in a large installation where the great bulk of the motors ran at a constant speed, it would probably be cheaper to install variable-speed, a.c. motors than to install converting plant. If a large number of variable-speed motors was required in any particular installation, it would be safer, cheaper, and more satisfactory to put in converting plant, than to install a.c. commutator motors.

Mr. E. W. Young pointed out that an objection to the type of motor shown in fig. 4c by Dr. Smith was that it was liable to hunt. He showed the speed range within which hunting occurred in a 5-15 b.h.p. motor at no load and full load. The speed variation would probably not matter greatly for most purposes, but for some a variation in speed of one per cent. was too great. Although, for a given load, there was only one speed at which hunting became a maximum and though the zone in which hunting could be detected was narrow, it should be borne in mind that hunting was a characteristic of those machines.

Dr. E. W. Marchant said Dr. Smith seemed to indicate that from the point of view of speed variation, the alternating-current commutating motor was better than the direct-current motor. That was not an intrinsic property of the motor. The greater ease with which the speed could be controlled was due to the ease with which variable pressures could be obtained with an alternating current. The weight of a single-phase commutator motor must always be greater than that of a d.c. motor of the same rating, because the "specific utilisation of the material" was always less effective than it was with direct-current machines; or, conversely, with a given size of motor, the rating with direct currents was much higher than with alternating currents. The three-phase commutator motor should prove a very valuable machine for special cases. The motor to which Mr. Teago referred had a very much higher efficiency at different speeds than an induction motor, and the commutation was remarkably good. The motor was a much more expensive machine to construct than the induction motor, and could only be used in such special cases as required a wide range of running speeds.

Mr. Charles Rettie was interested in connection with electric ship propulsion and heavy railroad work. But as a.c. commutator motors were out of the question for large powers, such as were used for the electric propulsion of battleships in America (the motors of which were anything from 7,000 to 22,000 h.p.) and as the low-powered ships such as cargo boats, ferryboats, and the like, would probably use direct current, as far as ship propulsion was concerned, the a.c. commutator motor could be ruled out. With regard to the possibilities of its use for heavy railroad work, it had a great future and though the Government had standardised the h.p., d.c. system, it was quite on the boards that before any great scheme was embarked upon, the approved system might be changed, especially in the light of recent developments which had taken place in Switzerland with the use of the single-phase system. As far as railway work was concerned, only one type of commutator motor need be considered, and that was the series-compensated type. The three-phase system was not likely to become popular, as according to reports from the Continent, though the three-phase system was in general use on the Italian railways, the fact that a double trolley line had to be used, made it unlikely that it would be adopted elsewhere. The author's statement that "with a single machine, voltage control is impracticable with direct current," would not apply in the case of d.c. motors used for the electric propulsion of ships, as the voltage of the generators could be varied to suit the speed. Mr. W. E. Shau, in his paper read before a combined meeting of naval architects, marine engineers, and members of the American I.E.E. in New York on December 17th, after mentioning the fact that alternating current would not be suitable for the Diesel electric drive for ship propulsion on account of the difficulties of running a.c. generators in parallel, went on to state; "the motors and generators being pure shunt-wound machines the motor speed is adjusted to any value within the requirements by the voltage control system. With direct current we have a choice between two methods of motor speed control, *i.e.*, armature rheostatic and generator voltage control. Armature control is not only unjustifiably wasteful at reduced-speed operation, but also adds complication to the control. On the other hand, the voltage control method is practically 100 per cent. more economical and provides an ease and flexibility of control unapproached by any other system." Regarding the author's statement with reference to the disadvantages of the induction motor either of the synchronous type or with the use of a phase advancer as being greater than those of any a.c. commutator motor, the speaker disagreed on that point because for large powers the types be referred to still held the field, as commutator motors could not be used in their place except as regarded the wound-secondary motors with which a small commutator motor was used for the phase advancer, and as had been proposed by Mr. W. E. Shau, to try and raise the power factor of the induction type of motor with slip rings as used for ship propulsion.

Mr. W. Holttum thought that whether they had been wise in avoiding the risk of burning their fingers over what seemed a doubtful proposition, might be difficult to say, but the result was certainly one to be taken to heart and pondered over.

Mr. T. D. Clothier's observations referred more to the

series of slides shown by Mr. Teago than to the paper. According to the slides, the particular commutator motor examined had a working speed range of from 500 to 1,500 r.p.m., with an efficiency of approximately 80 per cent. over that range, the power factor appeared to be 0.4 at 500 r.p.m. rising to 0.98 at 1,500 r.p.m. It seemed to him that under those conditions the consumer was not likely to benefit materially by using that type of motor if the supply was obtained on the kVA basis. Possibly as the particular motor in question was small, those characteristics might not apply to larger models of the same type.

To Mr. E. W. Ashby there seemed to be two aspects of commutator motors which were of particular interest. First, phase advancement was a very desirable application. It was exceedingly difficult to obtain small motors with high power factors, and an installation of small machines would probably work at an overall power factor of about .7 lagging. In such cases it was rarely practicable to put in a synchronous motor as the minimum size was about 150 kVA, but a few commutator motors with a leading power factor might well be installed. The leading power factor of a single-phase motor decreased with the load so that the wattless component would still be in evidence on light loads. A machine having such characteristics had been marketed by an American firm for some 10 years. The second aspect was that a variable speed a.c. motor with the same characteristics and ease of control as the d.c. interpole machine, produced at a reasonable figure, should have a large field. Commutation seemed to be the chief trouble with three-phase motors, restricting the voltage they could be designed for, or necessitating transformers. The fan drive case was met by a special form of the Hunt cascade motor having a second speed 2/3rds of the normal speed, the torque being proportional to the cube of the speed in accordance with fan requirements.

Dr. S. P. Smith, in reply to the discussion, said his difficulty had been to raise some controversy. The leading designers usually remained in their own country, while the mediocre imported ones appeared to have sought safety rather in standardisation than in development. They needed men who would look into the future, leaders, and not followers. To wait and see if the demand was as great as they hoped meant that in the meantime other people were developing. That was not creditable to British engineers.

It would generally be found that a higher power factor could be obtained with a commutator than with an induction motor.

Discussion at Birmingham.

At the fifth meeting of the 1921-2 Session of the South Midland Centre of the Institution at Birmingham on February 1st, Dr. S. P. Smith read his paper in the form of a lecture, and in the discussion that followed,

Mr. R. A. Chattock congratulated the author on the exceedingly able manner in which he had dealt with his subject, and on the method of delivery.

Prof. W. Cramp could not agree with the author that a direct-current motor with field control had a constant output over the whole range of its speed. He had always found that at the higher speeds the ventilation of the machine increased, so that when combined with the smaller field loss the armature current and power might be increased considerably for a given temperature rise. At the author's definite conclusion regarding the ultimate displacement of all forms of series a.c motors by the compensated-series induction motor, Prof. Cramp was rather surprised. Commutation evidently had been proved to be of more importance than power factor, so that they would again be faced with the demand for a wattless-current generator in railway generating stations. For work needing a shunt characteristic the most satisfactory machine the speaker had yet found was that described under fig. 5c, and he thought that machine should be developed in this country. Dr. Smith had referred several times to the unwillingness of supply authorities to make any concession to their consumers for improved power factor. With that complaint Prof. Cramp heartily sympathised. More than once he had offered on behalf of a consumer to put in a phase advancer, but had met with no support whatever from the supply authority. The lack of development of the a.c. commutator motor in this country was in no sense due to the lack of inventive genius or of patience and persistence. Dr. Smith had paid a just tribute to the astonishing early work of Atkinson; other workers in the field had been Wilson, Hunt, Fynn, and Creedy. All alike, with the exception, perhaps, of Hunt, had met with a chilly reception from manufacturers, of which he could speak with some feeling, and the same reception greeted the motors that he developed in 1900 and 1908. Yet that range of names accounted for practically every known form of a.c. commutator motor. Once again the history of aniline dyes was repeated—nor would development be stimulated by recent events. The decision of the Ministry of Transport's Committee in favour of d.c. for main lines in the face of Continental experience was a blow (it might be a mortal blow to the manufacturers of a.c. series motors in this country) and its effect would be reflected for many years in the orders that could be secured in England for machines required abroad. The original single-phase machine which Prof. Cramp put forward fourteen years ago was exhibited. Its characteristic was that of a series motor, with all the advantages of which they had heard so much; in addition there were manufacturing advantages, and since the ampere turns acting across the air-gap were due to the primary and secondary coils in opposition, the air gap could be made long and the poles short. The power factor, commutation conditions, and efficiency of the motor were all good, and, in addition, control could be arranged from tappings on the secondary coil. It should be ideal for fans and other machines that were made in quantities for stock.

Mr. R. Orsettich confined his remarks chiefly to stating the impracticability of getting out standard lines for 3-phase commutator motors. With reference to the voltage control of d.c. motors, mentioned at the beginning of the paper, he pointed out that that method was used very considerably in the regulation of large motors, such as rolling-mill motors, and also for the control of printing machines, and for paper-making machines—in all cases that entailed the use of an auxiliary generator or a booster to alter the supply voltage across the armature. With regard to the general application of commutator motors, one point had not been emphasised. There was no doubt that one of the main handicaps to the application of those motors was the fact that they worked well only with frequencies of 25 cycles and lower, and that the largest number of applications made and referred to in the paper had been for motors working with a frequency of 16⅔ cycles; 25 cycles appeared to be the absolute limit for traction work and, in fact, a number of experts disputed even that, and insisted on a lower frequency being used. Regarding the author's statement that a number of firms which were manufacturing different types of motors on the Continent had now given it up in favour of the series-wound motor with commutating poles, that was due to the patent situation. There were three or four organisations competing with one another, and each one had taken out patents covering its particular type. It continued to push that type as long as the patents of the competing firms were in existence, and only when the patents fell through were they in a position to adopt the motor which had proved best.

The reason for the very scanty attention paid to those motors in this country was mainly the fact that on the Continent the manufacturing companies owned or controlled a number of supply companies, and thereby could influence the adoption of the particular type of motor. Owing to the latest developments of power distribution in large towns the speaker believed that there would be a considerable field for small single-phase motors up to, say, about 10 or 15 h.p., where the supply company would not bring into a building any more than one phase of the three-phase distribution system.

With regard to three-phase commutator motors, there also would be a moderate demand for them up to, say, 25 h.p. for installation in factories where an economical speed regulation was required. Unless such motors were available the only other solution of the problem would be the installation of motor-generators and d.c. motors.

Dr. S. P. Smith briefly replied to points raised during the discussion.

INDUCTION-TYPE SYNCHRONOUS MOTORS.

Discussion at Newcastle-upon-Tyne.

Mr L. H. A. Carr, M.Sc. (Tech.), M.I.E.E., presented his paper on the above subject (which was abstracted in our issue of January 6th) at the North-Eastern Centre of the Institution of Electrical Engineers on January 9th.

Mr. Thomas Carter's opinion was that the really important point about the induction-type synchronous motor was that it was capable of being used for power factor correction. If anyone installed a motor of that type he ought very carefully to examine the case to ascertain whether he was paying the additional price of the machine merely to benefit the supply company without reaping any corresponding advantage himself. Unless the user of such a motor had an installation in which the cost of cables was a very large item, or unless he had his own generating station and wished to use his plant to the best possible advantage, the power factor at which his system worked usually need not particularly concern him; it was, however, greatly to the advantage of a supply company that power-factor-correcting apparatus should be installed on its system, and since the benefits were mainly for the supply company, the latter might reasonably be expected to be willing to pay for the benefits it received. It was scarcely fair to penalise a customer on account of power-factor, unless his power factor was materially worse than the average for his particular type of installation, and except under such circumstances a supply company could never reasonably demand the installation of power-factor-correcting apparatus by any of its customers; if, therefore, any consumer whose working conditions were normal installed a motor of the type described by the author, he really had a valid claim on the supply company for compensation, otherwise it was difficult to understand what inducement there was for anyone to install such a machine under any circumstances. After all, the

author's motor was very little different, so far as the user was concerned, from a corrected plain induction motor. The paper made one think that unless the full amount of power factor correction up to 0.9 was used the induction-type synchronous motor might suffer seriously in its overload capacity. It was very important to consider carefully which type of motor was better for any particular case, and while there was no doubt a wide field of usefulness for the author's type of motor, there were many instances in which its installation would not necessarily be worth the additional cost that would be incurred; and some in which its use would be a positive disadvantage.

Mr. F. H. Downie questioned whether there was much in the points that were raised in the paper as to the commutators. As to the winding of the rotor, reference was made to "two or four bars to the slot," but he had seen one with eight bars to the slot in the same class of machine, and the job was quite a good one. The machines were adapted for fans, compressors, &c., where the average power factor was very low, and if firms using those machines put in synchronous motors it would enable them to get more power developed from the same generating plant and that, of course, was an important matter, and meant a great saving. The use of that type of motor to drive generators would need care, because a constant-speed generator was inclined to be unstable.

Mr. A. B. MacLean thought there was no doubt but that a machine of the synchronous type would be needed in the future. Most supply companies were now making adjustments of tariffs, or putting clauses in tariffs, bearing upon power factor, and that would tend to create a demand for the synchronous motor of one type or another. There was only one advantage that the synchronous-induction motor had over the salient-pole machine, and that was the starting torque. As to the application of the machine to compressors, fans, and pumps, with regard to the first-named machine for instance, the salient-pole machine would meet the case, and the same might be applied to the centrifugal pumps. It would not apply to the same extent to the fans, because often it was not convenient to unload the fans. Apart from the starting torque, the salient-pole motor had the advantage everywhere over the synchronous-induction machine. His experience of the salient-pole machine was that it had a better efficiency by 1 or 2 per cent.; another thing was that it was easier to get a big overload capacity than with machines of the synchronous type; also the salient-pole machine was the cheaper.

Mr. J. M. Heslop thought that compressors could be started with 30 per cent. of the full-load torque, and centrifugal pumps could be got under way with considerably less than full-load torque, but the case of the colliery fan was different, and in that case the extra torque was going to be distinctly useful. The whole *raison d'etre* of the machine was the question of power-factor correction, which was becoming more and more important every day. In the future the consumer who was taking wattless kVA would have to pay for it. It was only just, right, and proper that he should pay. Now he was getting something for nothing the consumer would have to pay for what electricity cost in future.

Mr. A. T. Robertson explained that a feature of the synchronous induction motor that was claimed as an advantage over induction motors fitted with phase advancers, &c., might under certain circumstances appear as a disadvantage; correction to a leading power factor was not always desired—for example, one motor working at the end of a long transmission line—but with a synchronous induction motor, in order to obtain the necessary overload capacity, the size of the machine must be such that it would give a leading power factor of .85 or .9. Other things being equal, it would seem that phase advancers or vibrators had the advantage for that particular condition. Had a proper two-phase winding been tried? Because superficially one would imagine that when used as a d.c. exciting winding the copper would be used to better purpose than with a three-phase winding, two of the phases of which carried only half the exciting current.

He assumed that in calculating the slip of a motor from which it was to be synchronised the resistance of the exciter armature and brushes was included. That extra resistance would be small compared with the rotor resistance—say, about 10 per cent. of it, but it was conceivable if working close to the limiting slip that the exclusion of it from the calculations would mean the difference between the motor synchronising and not synchronising. It was stated that as the speed was not constant the angle swept through was not proportional to time, and the areas of the torque curves in fig. 1 were not proportional to the work done; that statement was not at all convincing as it stood, because one would imagine that a torque multiplied by an angle was proportional to work done irrespective of time or speed.

If a standard liquid starter with earthed dippers was used for the arrangement shown in the author's fig. 15 (*b*), the low-voltage exciter would be flashed every time the motor started with something like thirty times its normal voltage; it would seem to be worth while, therefore, to use with that arrangement an insulated starter and to earth the exciter.

The Chairman, Dr. W. M. Thornton, suggested that it was possible, having regard to their low-power factor, that shipyards might find synchronous-induction motors suitable for driving their pneumatic tools.

Messrs. J. Rosen, W. T. MacColl, and E. Fawsett added short contributions to the discussion.

Mr. L. H. A. Carr, in the course of his reply to the discussion, said if the power companies were going to continue to give things away with both hands, then the question of power factor did not apply, but if customers were going to pay what energy cost, then consumers would have to have regard to power factor. It seemed to be admitted that if they used induction machines properly they were saving coal, and that was a benefit, although they might have to fight it out to discover who should reap that benefit.

LEGAL.

Electro-Metals, Ltd., *v.* Malleable Steel Castings Co. (1909), Ltd.

In the King's Bench Division, on February 7th and following days, Mr. Justice Sankey was engaged in hearing an action involving the purchase of a 30-cwt. electric melting furnace from the plaintiffs, Electro-Metals, Ltd., the defendants, the purchasers, being the Malleable Steel Castings Co. (1909), Ltd., of Pendleton, Manchester. The plaintiffs claimed £1,239 odd, the liability for which was denied.

Mr. Inskip, K.C., and Mr. Wilfred Lewis appeared for the plaintiffs, and Mr. T. Eastham and Mr. R. Bennett for the defendants.

In opening the case Mr. Inskip said the amount sued for comprised £1,100, being the third instalment of a sum of £3,300, the agreed price of the furnace, and a number of small items in respect of certain materials required in connection with it which the plaintiffs ordered at the request of the defendants. The goods had been delivered and the plaintiffs said the defendants were liable to pay. The latter had set up a number of alleged breaches of the contract and warranties, some of which appeared to have been collateral and some expressed or implied in the contract. Defendants admitted that the furnace had been delivered and had been run by the plaintiffs' metallurgist, Mr. Needham, while it was being got into working order.

The furnace was still at Manchester at the defendants' works. They had used it and sold a considerable number of castings, the produce of the furnace.

The Judge remarked that he would determine what was the contract between the parties first.

Counsel did not think it would be possible for the furnace to be used without a good deal having to be done to it. It had not been used since the moulders' strike in 1919, when the men working it were forcibly driven out of the building, and parts of it had perished. The men employed by the defendants to work the furnace were quite inexperienced and unfit to engage in steel melting at all. Defendants were really Mr. Walsh, who, he understood, was never engaged in making steel castings until this furnace was installed. The whole of his business had been that of an iron moulder, and he (Mr. Inskip) was informed that an iron moulder had to forget all he knew about his trade in order to become proficient in the art of making steel castings. The order for the furnace was given on May 10th, 1918.

One of the complaints which the defendants made, said counsel, was that there had been delay in delivery and erection. He would only say that the electrical equipment was sub-contracted for by the plaintiffs, and a good deal of the delay was caused by failure of the sub-contractors to deliver. Further, delivery was made impossible for a long time, even if it would otherwise have been possible, owing to defendants' failure to provide the plaintiffs with the necessary lay-out plans.

Dealing with the defence, and a counterclaim by the defendants, counsel stated that they said the contract was partly verbal, arranged at various interviews between Mr. Edward Yates Walsh, representing the defendants, and Mr. James Bibby, on behalf of the plaintiffs, the latter being then joint managing-director of the plaintiff company. Defendants said it was an express term of the contract, or, in the alternative, the plaintiffs warranted that the furnace should be capable of producing steel of a tensile strength of 40 tons per sq. in. and 15 per cent. elongation unannealed. Plaintiffs said that that was neither an express term of the contract nor was it a collateral warranty, and indeed it was a warranty or representation which no melter or metallurgist would dream of giving. It was quite impossible to produce that quality of steel in practice as a commercial article, and the plaintiffs thought that defendants were under a misapprehension as to what annealing meant in the case of steel casting. The defendants, continued counsel, said that the plaintiffs warranted that the furnace would produce steel entirely to the defendants' satisfaction, and would not use more than 800 kWh of electricity per ton of metal melted. The first heat took place on July 29th, 1919. Defendants almost at once took up an attitude of dissatisfaction, and from that time forward complaints arose. The first was over the electrode holders, but that was remedied, and then disappeared entirely from the correspondence. The next matter complained of was the fuse boxes, which defendants said were not suitable, but the fuse and switch boxes were replaced, and they also dis-

appeared from the correspondence. With regard to the controllers, the plaintiffs admitted that the first design was not satisfactory, and they put in a new one, which met all requirements.

He (counsel) wished to make it plain that the plaintiffs gave no warranty except such as appeared in the correspondence. Having regard to the defects that appeared upon the first installation of the furnace, the plaintiffs' duty was to correct them, and that they did; they therefore said that the furnace was capable of doing what, under the contract, it was expected to do.

Evidence was then given.

Mr. James Bibby, formerly joint managing-director of the plaintiff company, gave evidence of interviews he had had with Mr. Walsh prior to the order for the furnace being given. Mr. Walsh wanted to be able to turn out railway truck and corporation castings and others of a crude kind. Witness declared that nothing whatever was said about 40 tensile tons per sq. in. with 15 per cent. elongation unannealed.

In cross-examination, witness denied that he told Mr. Welsh that a 30-cwt. furnace would consume 800 kWh.

Witness said he was not now connected with Electro-Metals, Ltd., but was a competitor. He agreed that Mr. Walsh had never taken over the furnace.

Do you suggest that the results that were got were due to unskilful and inefficient men?—Yes.

Dealing with the counter-claim, Mr. Eastham said the first three items, £25, £8, and £6, were admitted. The next was a claim for £1,643 19s. 6d., which the defendants had paid in wages in trying to get the furnace to work. They also claimed £960 paid to the Salford Corporation in respect of electricity and £350 in respect of 50 tons of metal which had been spoilt while Mr. Needham was at the works. Defendants were liable to consume electricity for 10 years at a minimum of £800 a year.

Mr. T. D. Robertson gave evidence that he was chief engineer in charge of the correspondence at the plaintiffs' London office, and had had 11 years' experience of electric furnaces. Steel at 40 tons tensile strength and 15 per cent. elongation would be a fairly hard steel. Apart from mild steel he had never heard of unannealed steel castings being sold, nor of anybody packing a steel casting with iron ore and annealing it in the way in which iron castings were annealed, nor had he known steel of 40 tons tensile strength with 15 per cent. elongation being produced without annealing. With ordinary good conditions an average of 800 kWh per ton should be obtained, and the feature about that furnace was that it melted steel scrap by electricity. The rest of the process depended to a great extent upon the human element.

Mr. Harold Needham, engineer in the employ of the plaintiffs, said he went to the defendants' works at Pendleton on June 25th, 1919, to superintend the starting of the factory which was then in course of erection. At the defendants' place there was a want of head room, which made tilting the furnace very difficult, with the result that they could not get the full charge into the ladle. The foundry roof, which was of wood, was so low that they could not take the furnace roof off when it got red hot. Occasionally a casting might have been satisfactory, but if so it was an accident, because the general quality of the moulds provided at these works was so very bad. Whenever he complained of the foundry—with the exception of the ladle, which Mr. Walsh could see was not satisfactory—Mr. Walsh replied that Mr. Bibby had guaranteed the results.

Mr. Hayden Cornthwaite, who at the time was manager of the Sheffield branch of Messrs. Electro-Metals, gave evidence, and Mr. F. A. Melmoth, foundry manager to the Braintree Castings Co., and consulting metallurgist to the National Steel Foundry, Leven, said they had three of the Electro-Metals two-ton electric furnaces at Braintree and one at Leven, and were perfectly satisfied with the results obtained. The whole thing came back to the personality of the person handling them.

(To be continued.)

Chamberlain & Hookham *v.* Solar-Zahlerwerke.

The *Birmingham Post* reports that a judgment was given by the Anglo-German Mixed Arbitral Tribunal in London last week in the action by Messrs. Chamberlain & Hookham, Ltd., electrical manufacturers, of Birmingham, against the Solar Zählerwerke G.m.b.H., a subsidiary company in Hamburg, in which they held all the shares. (See Elec. Rev., December 16th, 1921, p. 816.)

Delivering judgment in favour of the claimants, M. Borel, president of the Tribunal, dealt with the contentions of the German Clearing Office, and said it was clear that, both in English and in German law a company was a legal entity distinct from its shareholders, and that in the event of a liquidation of the German company before the war the claimants could only have ranked as creditors, and could not have claimed the whole assets as shareholders. On the point of nationality, both the Treaty of Peace Orders 1919 to 1921 and the corresponding German orders of August 31st, 1919, and April 13th, 1920, defined "nationals" of any State as including any company or corporation incorporated therein according to the law of that State. On this point also the contentions of the German Clearing Office failed. There were certain items in dispute, and on some of these the claimants had given way. There would be judgment for the claimants for £20,438 and £100 costs.

British Thomson-Houston Co., Ltd., *v.* Corona Lamp Works, Ltd.

The hearing of the above action was continued on February 8th before Mr. Justice Astbury, in the Chancery Division.

Prof. Boys said he had read and considered the plaintiffs' specification and the various documents that were relied upon in defendants' particulars of objection. He also made one or two calculations relative to the alleged infringing lamps, and he had tried to seal in a wire according to the plaintiffs' specification. He had also considered the alleged prior users.

Sir A. Colefax, K.C., for plaintiffs, asked the witness to take it from him for the purpose of his questions that there were two elements in the plaintiffs' invention which were combined; one, the feature of proportioning a composite wire so as to get the same co-efficient of expansion as that of glass; and the other, the feature of taking a metal for the outside or coating whose oxide was soluble in glass at a relatively low temperature. Do you, asked counsel, find in any of the prior documents that combination disclosed?

Prof. Boys said he did not find that combination in any of them.

At the date of plaintiffs' patent was there any common knowledge which would have led one to proportion a composite wire in the way in which the plaintiffs' specification does?

No, it is a new subject; it was not known or discussed before.

Dr. Otho Oberlander gave the results of certain tests he had made with ten of the alleged infringing lamps and of analysis of the defendants' wire.

Mr. E. A. Gimingham, technical director of the Ediswan Electric Co., Ltd., said that for a long time it was thought essential, in order that they might make a successful seal, that they should use a platinum leading-in wire, and they always used platinum until they had this substitute. Platinum and platinum-coated wires were universally used down to the date of the plaintiffs' patent. His company had manufactured millions of lamps with copper-clad nickel-iron wire.

On February 9th Sir A. Colefax, K.C., summed up the case for the plaintiffs, and said their specification was a clear and well-drawn document. At one time the issues would narrow down to want of subject matter, and he confessed he was in some difficulty to know what the issues between them were.

Mr. Frost (for defendants) said they were not going to rely on the first three of the particulars of insufficiency.

Sir A. Colefax said in that case the defendants were apparently still to place some reliance on the last particular, which was a very curious one: "No directions are given as to whether the expansion of the wire is to be measured in a radial or longitudinal direction." The short answer was that one did not measure the expansion in any direction at all. One would construct a wire in accordance with this specification. He (counsel) submitted that the mere measurement of the expansion in length was not that which should be considered.

Sir Arthur next addressed the Court on the issue of infringement, and contended that the lamps, twelve in number, sold by the defendants, fell within the claim in plaintiffs' specification.

His Lordship was not at present troubled with any of the anticipations, but the thing that did trouble him was the construction of the specification with regard to claim 3. Claim 1 incorporated the proper co-efficient of expansion; claim 2 expressly claimed a coating of copper provided they had got the combination of claim 1, but claim 3 simply claimed a core of tungsten and a sleeve of copper, and it did not say that it had to be proportioned as in the patent.

Mr. Frost (in the absence of Sir Duncan Kerly, K.C.), opened the case for the defendants. He said the issues were subject matter and infringement. Before this patent, wires of nickel-iron core covered with platinum were known and worked, and he submitted that at the date of the patent defendants had a perfect right to take that wire and substitute for the platinum something else which was known to have the property of getting the wire to stick.

His Lordship said that certain alternatives to platinum were suggested, but there was not a single document in this case which suggested that one could take off a platinum covering from a composite wire and substitute the very thing that platinum was used to avoid.

Mr. Frost said the queston was whether the inventor in this case was the first man to place at the disposal of the public the free and unfettered use of metal whose oxide was soluble as a means of sticking glass on a composite wire. If he was not, then he could not have his patent.

The hearing was adjourned till February 14th, subject to the finishing of another case fixed for that day.

Is an Electric Truck a Light Locomotive? (Correction.)

In a report under the above heading, in our issue of February 3rd, we referred to a firm called "Electrical Vehicles, Ltd." Our report, as already stated, was taken from the *Manchester Guardian*, which should have given the name as "British Electrical Vehicles, Ltd."

British Thomson-Houston Co., Ltd., v. B.T.T. Electric Lamp Accessories Co., Ltd.

Mr. Justice Eve, in the Chancery Division on Friday, granted an injunction to the British Thomson-Houston Co., Ltd., restraining the B.T.T. Electric Lamp & Accessories Co. from supplying ½-watt-type lamps (which it was alleged were an infringement of the former's letters patent) until further order.

Sir Arthur Colefax made the application on behalf of the British Thomson-Houston Co., and his motion was opposed by Sir Duncan Kerly, on behalf of the B.T.T. Co.

Sir Arthur explained that the patent was the subject of litigation between the present plaintiffs and the Corona Lamp Works, Ltd., which subsequently went to the House of Lords. Their Lordships' decision had been given in favour of the plaintiffs, supporting the patent and holding it to be valid and to have been infringed.

With regard to the present action, it seemed to him that the infringement was in fact admitted. What the defendants said was that if certain facts were proved it would be held that the patent was invalid. It was not said that the facts could be proved, although the question raised was merely that of validity, which had been in question for eight years before being held to be valid after very protracted litigation. It was also said by the present defendants that the patent had been declared valid on the assumption that a discovery, on which it was based, was new, whereas they said it was not. With regard to that, Sir Arthur pointed out that he had himself protested against the subject-matter of the patent being regarded upon any such limited basis, and on that their Lordships had been in his favour. They had looked at the patent irrespective of whether it was new or not.

Passing to the facts of the present case, Sir Arthur explained that defendants had an advertisement in the Electrical Review of September 30th, 1921, in which they said they had branches in all parts of the country and offered Dutch ½-watt-type lamps for sale. On October 14th they said in another advertisement that they had the largest stock of any lamp manufacturers in the United Kingdom. In December the plaintiffs inserted an advertisement referring to the House of Lords' decision. That was followed by one from the defendants on January 6th, 1922, repeating their previous advertisement with some alterations. They there announced an arrangement they had made with the Stella Lamp Works for the latter in future to supply ½-watt-type lamps.

Sir Arthur then submitted that such action was an infringement of the patent, and asked for an interlocutory injunction.

Sir Duncan Kerly, for the defendants, observed that the patent had been granted as long ago as 1913, and a great trade had been built up, which the plaintiffs now asked his Lordship to say must be summarily stopped without any further trial. Furthermore, the plaintiffs had waited for six weeks after the decision of the House of Lords before taking any action against the defendants. The advertisements were before them before that decision was reached, and counsel thought that in those circumstances this was not a case where the matter should be brought to a point which might be disastrous to the people he represented.

It was a practice of the Court, continued Sir Duncan, in circumstances such as these not to make an order where the validity of the patent was really going to be contested. In the previous action the whole argument on the subject-matter was the alleged discovery made by Dr. Langmuir. The defendants had now discovered that that alleged discovery had been published before the date of the specification in question. He (Sir Duncan) had not been able to make use of that fact in the arguments of the old case, but he was now in a position to submit to the Court that it would have made an appreciable difference in the way the whole matter had been looked at. Documents would show that the alleged discovery was not new. On those grounds he contended that no order should be made.

His Lordship said he had no evidence before him that the granting of an injunction would cause irreparable damage to the defendants. In the absence of such evidence he could not interfere with the ordinary practice of the Court in such cases. There would therefore be an injunction granted until further order.

CYC-ARC AUTOMATIC ELECTRIC WELDING.

Discussion at Manchester.

The paper on the above subject, by Messrs. L. J. Steele and H. Martin (an abstract of which appeared in our issue of December 9th, 1921) was read by Mr. W. J. Scott at the meeting of the North-Western Centre of the Institution of Electrical Engineers at Manchester on January 24th, both authors having been stricken with influenza. Mr. Scott gave a practical demonstration of the process, but at the request of the authors the reply to the discussion was postponed.

Mr. L. Miller regarded the production of the Cyc-arc apparatus as a distinct step in the progress of electric welding; it eliminated the human element very well. The authors had made very complete tests on the welding of studs, and were in a position to provide very accurate information on those conditions. The timing apparatus was quite good, and could not be greatly improved. With regard to the type of generator described in the paper, the authors would agree that he had demonstrated to them that quite as good results could be obtained at much less cost with a simple compound-wound generator with a reversed series winding. The use of that type of generator slightly simplified the apparatus and, at the same time, had very great advantages when very heavy currents were required.

Mr. Anderson doubted whether the authors would get old-fashioned mechanical engineers to look with any degree of favour upon their system for the welding of studs. Among mechanical engineers generally there was a great objection to the use of electricity in making mechanical connections. So far as the apparatus was concerned it was designed very well indeed, and there was a great future for it.

Mr. A. B. Field, in connection with the welding of dissimilar metals, thought brazing was the correct term ,and referred to the work done by Chubb in the States about 1912 or so. He was able to weld aluminium and copper, and the speaker thought he also welded lead and platinum—metals with very dissimilar melting points—by simply giving a very rapid condenser discharge through the contact. That had not become very well known in this country, but it had been used a good deal for small work.

The Chairman invited Prof. Stoney to express an opinion on the application of the system to the welding of turbine blading, but Prof. Stoney did not think any possible system of welding was absolutely reliable, and for turbine blading absolute reliability was essential.

Mr. Robson pointed out that, in connection with the bonding of railway lines, one of the difficulties of the system would be the amount of apparatus which appeared to be necessary. If a railway line was going to be electrified, of course the service had to be kept going all the time, and it was difficult to see how a petrol-engine generator and the apparatus exhibited could be brought alongside, say, a viaduct.

Mr. Binn's point seemed to be that after the stud was welded the rail bond must be completed at a later time by some other method—either cold welding, or say, sweating.

Mr. Blakeman said, with reference to the special magnetic generator mentioned by the authors, it would appear to be an auto-connected single-armature generator set, and he wanted to know whether they could give any definite figures regarding the power taken by that machine.

The Chairman, in conclusion, explained that Mr. Scott had himself been associated with the development of the process.

CANADIAN NOTES.

(From our Special Correspondent.)

In spite of the strong recommendations of the International Joint Commission regarding the early development of the power of the St. Lawrence River, it is not likely that any real action will be taken for some time, because New York State has already planned and organised strong opposition to the scheme as being too expensive, unnecessary, of little value, and generally unsound.

If the scheme does go through, Canada, for some few years, will of necessity have to find a market for the enormous quantity of power developed, in the North-Eastern United States, and probably will be able to do so without serious difficulty, as this territory includes, within transmission distance of the power sites, a very considerable portion of the "Super-power zone," which embraces the most highly-industrialised section of the United States. The difficulty confronting Canada, in the event of power being exported on a large scale for several years, will be to keep this power back for use in Canada when it is required, as, in time, it undoubtedly will be; notwithstanding short-term agreements to the contrary it would not be easy to withdraw the power from the United States.

The development of 650,000 h.p. by the opening of the Queenston-Chippawa undertaking is a great engineering achievement, and there can be no doubt that, by having this power actually available for use South-western Ontario will become a great industrial centre during the next few years, because it now possesses an abundant supply of power which can be readily transmitted over an area having a radius of 250 miles, power which will be sold at cheap rates.

Canada has, however, still a long way to go before all her water-powers are fully developed, for, according to recent data published by the Water Powers Branch of the Department of the Interior, there is available 18,255,000 h.p. at ordinary minimum flow, or 32,076,000 h.p. at the estimated flow for maximum development. Out of this available power less than 2,500,000 h.p. is at present utilised. A curve prepared by the Water Powers Branch to indicate, on the past rate of increase, what will be the amount of development in the future shows that in 1936 the 2,500,000 h.p. will have become 5,000,000 h.p.; this is probably an under-estimate, since the rate of growth will almost certainly increase in the future.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

2,396. "Electrical relays." Metropolitan-Vickers Electrical Co., Ltd. January 26th. (United States, February 26th, 1921.)
2,399. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. January 26th.
2,400. "Lightning arresters, &c." British Thomson-Houston Co., Ltd. (General Electric Co.) January 26th.
2,401. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co.). January 26th.
2,412. "Electrical sorting machines for sorting perforated statistical, &c., cards." F. R. Bull. January 26th. (Norway, November 28th, 1921.)
2,416. "Electric wall plug." W. Gee. January 26th.
2,430. "Machines for coating current-conducting wires and cables with asbestos, cotton, &c." F. Chiantore. January 26th.
2,438. "Thermionic valves for wireless telegraphy, &c." H. G. Hughes, S. R. Mullard, and L. G. Preston. January 26th.
2,458. "Electric egg-tester." G. F. Evans. January 27th.
2,479. "Ignition devices." R. Bosch Akt. Ges. January 27th. (Germany, January 29th, 1921.)
2,500. "Sparking plug." N. H. Russell. January 27th.
2,511. "High-tension transformers." E. Haefely et Cie. Akt. Ges. January 27th. (Switzerland, February 9th, 1921.)
2,513. "Synchronous telegraphic systems." J. V. Foll and Western Union Telegraph Co. January 27th.
2,515. "Pyrometers." British Thomson-Houston Co., Ltd. (General Electric Co.). January 27th.
2,516. "Current-conducting seals for electric apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). January 27th.
2,517. "Telephone systems." G. Deakin and Western Electric Co., Ltd. January 27th.
2,521. "Telegraph transmitters." J. V. Foll and Western Union Telegraph Co. January 27th.
2,523. "Electric propulsion of ships." C. C. Garrard and A. H. Railing. January 27th.
2,525. "Electrical foot warmers for vehicles." I. Panza. January 27th. (Italy, January 31st, 1921.)
2,536. "Radio-receiving systems." Ges. fur Drahtlose Telegraphie. January 27th. (Germany, January 31st, 1921.)
2,560. "Incandescent electric lamps." General Electric Co., Ltd. January 27th. (Germany, February 4th, 1921.)
2,581. "Method of signalling and telephoning without special conductors." H. Green. January 28th.
2,589. "Electric sound-producing horns." T. S. Rogers. January 28th.
2,592. "Boxes for carrying electric lamps." A. H. Stevenson. January 28th.
2,620. "Tuned wave transmission." F. D. Maclean. January 28th.
2,632. "Electric signs." L. G. W. Guest and H. O. Merriman. January 28th.
2,641. "Electric lamps." A. MacCallum. January 28th.
2,676. "Windings of electrical coils." U. Beaton and C. B. Kersting. January 30th.
2,686. "Relay or magnetic circuit for relays, &c." W. J. Minton. January 30th.
2,689. "Apparatus for ascertaining and indicating capacity of electric accumulator." P. J. Gumbley. January 30th.
2,698. "Electric lamp bulbs." E. A. Hailwood. January 30th.
2,699. "Junction box, &c., for low-tension electric circuits of motor cars or telephone bells, &c." L. Bussereau and R. Thorne. January 30th.
2,706. "Electromagnetic overload circuit breakers." F. Krupp Akt. Ges. January 30th. (Germany, February 24th, 1921.)
2,712. "Ignition starting devices for magnetos." V. Boscato. January 30th.
2,717. "Electric incandescent lamps." R. Cavedoni and E. Marinelli. January 30th.
2,728. "Electrodes for electric arc welding." A. C. Hyde. January 30th.
2,735. "Electric fires, &c." Electric Fires Ltd., F. L. Newhouse and C. H. Smith. January 30th.
2,736. "Telephone systems." Siemens & Halske Akt. Ges. January 30th. (Germany, January 31st, 1921.)
2,738. "Automatic electric switching systems." H. Baron (F. Aldendorff). January 30th.
2,748. "Electrodes for welding, &c." H. D. Lloyd, Whitecross Co., Ltd., and W. W. Wilson. January 30th.
2,757. "Galvanic batteries." G. Oldham and J. Oldham. January 30th.
2,762. "Voltage regulator for electric alternating circuits." Johnson and Phillips, Ltd., and H. M. Lacey. January 30th.
2,764. "Induction train control systems." J. B. Regan. January 30th.
2,769. "Dynamos." A. D. Mackenzie. January 30th.
2,778. "Electrically steering movable objects at a distance." Soc. Industrielle des Procédés, W. A. Loth. January 30th. (France, October 12th, 1921.)
2,782. "Connecting insulator for high voltages." Allgemeine Elektricitats Ges. January 30th. (Germany, January 31st, 1921.)
2,785. "Electric controllers." L. Satchwell. January 30th.
2,791. "Electric resistances." E. S. Gray. January 31st.
2,797. "Electric switches, switch fuses, &c." H. E. Sutherland. January 31st.
2,798. "Electric switches, switch fuses, &c." H. E. Sutherland. January 31st.
2,824. "Electrically-operated stop motions for textile, &c., machines." R. H. Derry. January 31st.
2,828. "Head lights." J. H. Sutherland. January 31st.
2,855. "Electric generator field regulators, &c." H. C. Hodges. January 31st.
2,859. "Dynamo-electric machines." E. E. Daglish, W. L. Lorkin and H. B. Swift. January 31st.
2,870. "Methods of making articles of silica." British Thomson-Houston Co., Ltd. (General Electric Co.). January 31st.
2,871. "Protective devices for enclosed electrical apparatus." British Thomson-Houston Co., Ltd., and F. H. Clough. January 31st.
2,885. "Burglar, &c., alarms." W. Slatter. January 31st.
2,897. "Thermo-electric pyrometers." Birmingham Small Arms Co., Ltd., and A. R. Page. February 1st.
2,930. "Electric heating and cooking." W. B. Topp. February 1st. (Australia, February 5th, 1921.)
2,934. "Electric switches." Cable Accessories Co., Ltd., and F. H. Reeves. February 1st.
2,935. "Electric switches." Cable Accessories Co., Ltd., P. W. Davis and F. H. Reeves. February 1st.
2,936. "Electric switches." Cable Accessories Co., Ltd., P. W. Davis and F. H. Reeves. February 1st.
2,940. "Electric current collectors for tramways, &c." W. H. Clinkard and E. Nicholls. February 1st.
2,952. "Accumulators." H. Leitner. February 1st.
2,963. "Electric transformers." English Electric Co., Ltd., J. W. Howard and J. A. St. C. Richardson. February 1st.
2,964. "Receiving apparatus for wireless telegraphy and telephony." G. F. Auckland. February 1st.
2,967. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. February 1st. (United States, February 19th, 1921.)
2,973. "Head lights of motor vehicles, &c." N. Barraclough, A. Bowman and J. F. Faulkner. February 1st.
2,976. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. February 1st.
2,977. "Electric circuit controlling devices." P. G. Broom. February 1st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

16,712. "Microphones or telephone transmitters." J. M. Furnival. October 20th, 1920. (174,093.)

1920.

10,831. "Thermal switches for electrically-heated apparatus." F. W. R. Lee and E. R. Lee and V. F. H. Golledge. October 20th, 1920. (174,094.)
19,188. "Electro-hydraulic steering apparatus." San Giorgio Soc. Anon Industriale. September 17th, 1918. (147,145.)
19,565. "Device for strengthening telephone currents and other electrical oscillations." Schuchhardt Berliner Fernsprech Und Telegraphenwerke F. May 14th, 1917. (Addition to 147,579.) (148,182.)
20,092. "Reception of continuous electric oscillations." Ges. Fur Drahtlose Telegraphie. October 15th, 1915. (148,182.)
20,262. "Cableway cranes." K. Dittlebach. December 30th, 1918. (148,344.)
20,308. "Electric high-frequency signalling." A. van T. Day. July 17th, 1916. (148,380.)
20,364. "Receiving device for submarine sound signals with a receiving member abutting on the water and a detecting device." Signal Ges. August 10th, 1917. (Addition to 147,947.) (148,417.)
20,632. "Apparatus for rhythmically influencing electric waves produced by cathode tubes." Dr. E. F. Huth Ges. and Dr. L. Kuhn. April 3rd, 1919. (148,801.)
20,635. "Switching arrangement for wireless signalling, particularly for aeroplane sets." Dr. E. F. Huth Ges. September 8th, 1916. (148,804.)
20,883. "Electromagnetic wave-receiving arrangements." Ges. fur Drahtlose Telegraphie. February 8th, 1916. (148,992.)
20,926. "Wireless telephony." Dr. E. F. Huth Ges. December 31st, 1917. (149,011.)
20,928. "Installation for the operation of Rontgen tubes." Dr. S. Loewe. March 5th, 1919. (149,013.)
20,929. "Arrangement of connections for generating and receiving electrical oscillations." Dr. E. F. Huth Ges. May 2nd, 1919. (149,014.)
20,934. "Method of connection to produce oscillations with vacuum tubes." Dr. E. F. Huth Ges. and Dr. S. Loewe. July 16th, 1917. (149,195.)
20,936. "Antenna for wireless telegraphy." Dr. E. F. Huth Ges. and B. Rosenbaum July 14th, 1915. (149,197.)
20,937. "Connection for sending and receiving electric waves." Dr. E. F. Huth Ges. October 13th, 1917. (149,198.)
20,956. "Combined wireless transmitting and receiving arrangement." Dr. E. F. Huth Ges. December 15th, 1917. (149,209.)
20,958. "Electric discharge vessels." Dr. E. F. Huth Ges. December 29th, 1917. (149,211.)
20,961. "Wireless telephone transmitters." Dr. S. Loewe. October 29th, 1918. (149,214.)
20,962. "Arrangements for the combined transmission and reception of wireless signals." Dr. E. F. Huth Ges. and B. Rosenbaum. August 28th, 1917. (149,215.)
20,993. "Process for wireless telegraphy and telephony." Dr. E. F. Huth Ges., B. Rosenbaum, and Dr. S. Loewe. August 18th, 1917. (149,235.)
20,995. "Thermionic receiving apparatus for wireless signalling." Dr. S. Loewe. April 18th, 1918. (149,237.)
21,003. "Thermionic receiving systems for wireless and wired wireless signalling." Dr. E. F. Huth Ges. October 13th, 1917. (149,240.)
21,060. "Vacuum tube." Dr. S. Loewe. April 20th, 1918. (152,311.)
26,043. "Mounting clips for electric switchgear." W. J. Line and J. H. Tucker & Co., Ltd. September 10th, 1920. (174,118.)
27,709. "Negative resistance devices particularly for electro-magnetic wave systems and the like." J. Scott-Taggart and Radio Communication Co., Ltd. September 30th, 1920. (Cognate application 17,839/21.) (Patent of addition not granted.) (174,134.)
27,932. "Induction furnaces." W. C. Heraeus Ges. and W. Rohn and Stahlwerke R. Lindenburgh Akt. Ges. May 19th, 1920. (163,276.)
28,387. "Electric switches." F. Painter and G. H. Ide. October 7th, 1920. (174,137.)
28,972. "Electron discharge devices for use as valves or oscillators." British Thomson-Houston Co., Ltd. (General Electric Co.). October 13th, 1920. (174,149.)
28,997. "Electric starters for internal-combustion engines." R. Hadden (Neumayer Akt. Ges. F.). October 13th, 1920. (Convention date not granted.) (152,355.)
29,225. "Brush-gear for electrical machinery." W. H. Glaser, A. L. Wickens and W. H. Glaser, Ltd. October 15th, 1920. (174,163.)
29,530. "Device for testing the electric ignition of internal-combustion engines." V. F. M. Oliver. October 19th, 1920. (174,185.)
29,639. "Searchlight and other projectors." Sir C. A. Parsons, E. Bennett and H. Rowe. October 20th, 1920. (Addition to 152,728.) (174,192.)
30,002. "Drop electric lamps." H. E. Hadwen and H. Willis. October 23rd, 1920. (174,202.)
30,146. "Method of operating vacuum tubes." E. Schaeffer. August 26th, 1919. (153,002.)
30,147. "Method of operating vacuum tubes." E. Schaeffer. October 24th, 1919. (Addition to 153,002.) (153,003.)
30,984. "Electro-magnetically-operated circuit-controlling devices." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). November 2nd, 1920. (174,223.)
31,371. "Call distributing arrangements for telephone plants." G. A. Betulander. November 22nd, 1919. (154,582.)
31,833. "Loose-handle electric circuit breakers, current limiters, overload releases, prepayment meter switches, and the like." R. Amberton and E. N. Bray. November 10th, 1920. (174,242.)
32,589. "Alternating current relays." McKenzie Holland and Westinghouse Power Signal Co., Ltd. August 6th, 1920. (167,446.)

1921.

372. "Renewable electric fuses." A. L. Eustice. March 31st, 1919. (156,496.)
657. "Fusible cut-outs and distribution fuseboards for electric circuits." H. C. Hodges. January 6th, 1921. (174,279.)
1,679. "Electric systems of ship propulsion and the like." Soc. des Ateliers de Constructions Electriques du Nord et de l'Est. May 25th, 1915. (158,238.)
7,889. "Means for supporting thermionic valves." A. R. Taylor. March 12th, 1921. (174,298.)
9,107. "Casings for voltmeters, ammeters, and similar instruments." Tube, Ltd., and E. W. P. Lines. March 24th, 1921. (174,299.)
14,318. "Low-voltage protective circuit-controllers." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). May 23rd, 1921. (174,304.)
24,765. "Thermionic transmission systems for wireless telephony." M. Latour. November 20th, 1916. (Divided application on 19,760/20.) (169,442.)
26,802. "Apparatus for the influencing of electric waves produced by cathode-tubes, and more especially for telephony without wires or along wire." Dr. E. F. Huth Ges. and Dr. L. Kuhn. December 2nd, 1919. (Divided application on 148,801.) (Addition to 148,801.) (170,013.)
29,292. "Submarine signalling." R. A. Fessenden. March 23rd, 1918. (Divided application on 18,307/20.) (171,103.)

1922.

421. "Electric high-frequency signalling." A. Van T. Day. January 25th, 1919. (Divided application on 148,380.) (174,312.)